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AFRAID TO BE A NERD:
EFFECTS OF NERD STEREOTYPES ON WOMEN'S MATH PERFORMANCE

by

JENNIFER CHAU
(Under the Direction of Amy A. Hackney)

ABSTRACT

The purpose of this research was to examine whether nerd stigma affects math performance. Specifically, it was hypothesized that women exposed to the nerd stigma would perform worse on a mathematics test than women not exposed to the nerd stigma. The current study also aimed to compare the effects of the nerd stigma on women's math performance with the effects of gender stereotype threat. Gender identity, nerd identity, and fear of social exclusion were examined as possible mediating and moderating variables. Results did not support that nerd stigma affected math performance in either men or women, thus mediational analyses were not warranted. Mixed results were found for the moderator analyses. Results showed that nerd identity moderated the effect of the nerd stigma in women, unexpectedly suggesting that women high in nerd identity performed worse on the math test when exposed to the nerd stigma condition. The results also showed a stereotype boost effect for men, such that men performed better on the math exam under the gender stereotype condition. The results found in this study provide a better understanding of the relationship between nerd stigma and its effect on women's math performance. The implication of these results is that nerd stigma effects may help to explain the gender gap in math performance and further research is warranted.

INDEX WORDS: Nerd, stigma, stereotype threat

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JENNIFER CHAU

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JENNIFER CHAU

Major Professor: Amy A. Hackney

Committee: Ty W. Boyer

Karen Z. Naufel

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DEDICATION

To my family for being so wonderful in understanding and supporting my decision in this educational endeavor. To Pablo Lozano for all the encouragement and especially patience you provided throughout this two year journey. I would never be where I am today without every one of you.

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CHAPTER 1

INTRODUCTION

The gender gap between males' and females' performance in mathematics, with men performing better than women on mathematical tests, has been known and studied for quite some time. Currently, researchers are trying to identify the mechanisms that underlie this gender gap in mathematics. According to 1975-2008 statistics reported by the National Science Foundation [NSF], on average, the same percentage of women enrolled in college as did men (Figure 1). In fact, starting in the late 1980s, the percentage of women enrolling in college slowly increased until 2008 at which time over 15% more women enrolled in college than did men. NSF's statistics showed that men and women have similar college enrollment rates, indicating that both sexes share similar intellectual abilities to at least be accepted and attend college. In a recent meta-analysis of 242 studies on gender differences in mathematics performance, results showed that men and women performed similarly in mathematics (Lindberg, Hyde, Petersen, & Linn, 2010). The meta-analysis included studies published between 1990 and 2007 and tested for differences between sexes in separate age groups (Lindberg et al., 2010). Lindberg et al. (2010) found negligible gender differences in elementary school and middle school aged children, a slight difference in high school students, but then the difference declined for college aged samples and adults. But surprisingly, the College Board's statistics on SAT scores show that women, on average, consistently performed more than 30 points lower than men in SAT math scores between 1971-2009 (Perry, 2009; Figure 2). A 30 point gap is relatively large considering women performed on average only 13 points higher than men in writing and men performed 5 points better than women on critical reading in 2009 (College Board, 2009). A major question then is, why did Lindberg et al. (2010) find negligible differences in men and women's math performance in school, but women are underperforming compared to men on math tests such as the SAT?

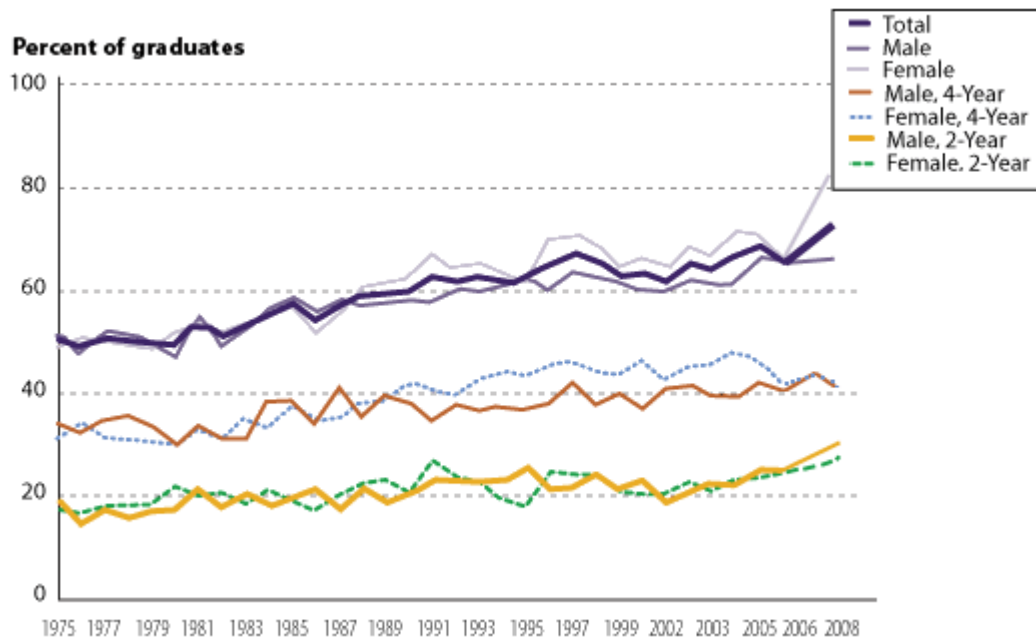


Figure 1. Percent of high school graduates who enroll in college the fall after graduating, by sex and school type: 1975-2008. Women are gradually enrolling in college more than men overall and completing 4-year or 2-year colleges similarly as men.

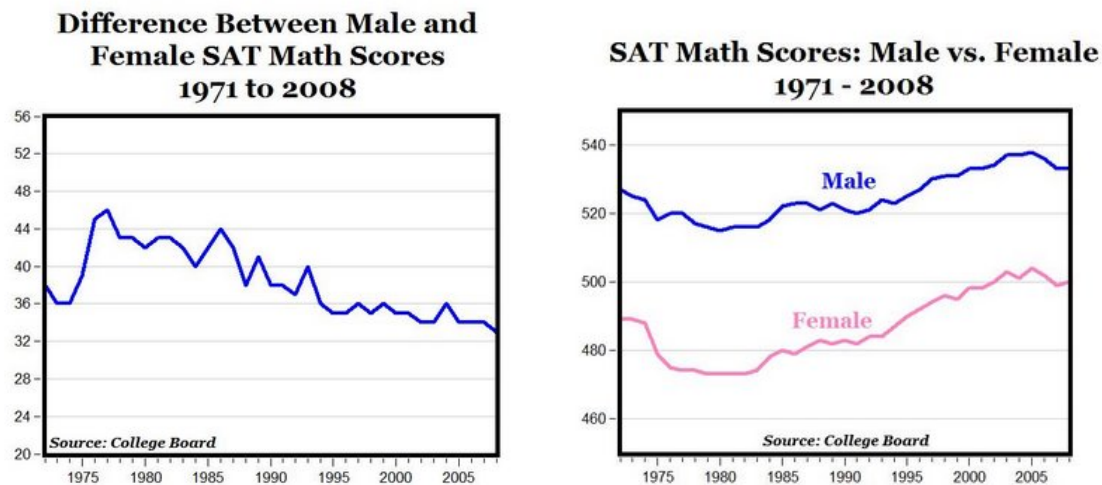


Figure 2. Long term trend showing average women SAT math scores lower than average men SAT math scores.

Stereotype threat has been cited as a possible mechanism underlying the gender gap in mathematics test performance. Studies on stereotype threat, defined by Steele and Aronson (1995, p. 797) as “being at risk of confirming, as self-characteristic, a negative stereotype about

one's group," have indicated that women are performing worse on mathematics tests because testing situations put them at risk of confirming the negative stereotype that men are better than women in mathematical abilities. Research on stereotype threat has shown that female participants performed significantly worse on a math task in various types of conditions eliciting stereotype threat, such as reading, hearing, or watching messages that primed the stereotype that women are worse at math than men (Davies, Spencer, Quinn, & Gerhardstein, 2002; Schmader, 2002; Spencer, Steele & Quinn, 1999). Even coloring a picture of a young girl holding a ball or being the minority gender in a testing room has shown to lead to a decrease in math performance for female participants, but not male participants (Inchlicht & Ben-Zeev, 2000; Neuville & Croizet, 2007). Although stereotype threat research has examined many different variables influencing women's performance on quantitative tests, it does not address the social aspects involved in performing well in a subject such as math. The following research attempted to demonstrate why it is necessary to examine the gender gap in mathematics in relation to how math-able women are perceived by their social group.

Among German high school students, Rentzsch, Schutz, and Schroder-Abe (2011) found that high achieving students who put a lot of effort into school were generally less liked by their peers. Boehnke's (2008) study on peer pressure showed that there was a strong negative relationship between abilities, fear of social exclusion, and grades for girls, but not boys. Girls who had higher academic ability and higher fear of social exclusion had lower grades than girls with lower ability and lower fear of social exclusion. Other research has shown that the label nerd is feared by students who receive good grades and this fear was even predictive of lower achievement in mathematics (Pelkner & Boehnke, 2003; Pelkner, Gutner, & Boehnke, 2002, as cited in Rentzsch et al., 2011). The strong negative relationship between abilities, fear of social exclusion, and grades found for girls and not boys suggests that girls are affected by fear of social exclusion more than boys. Thus, it seems possible that women may be performing worse on mathematics exams because they fear being labeled a nerd.

Because stereotype threat focuses on a negative stereotype about one's *own* group, the fear of being labeled a nerd does not directly align with stereotype threat research. Instead, in general, the fear of being labeled a nerd more closely fits with the concept of stigma. Crocker, Major, and Steele (1998) argued that "in essence, stigma is a devaluing social identity" (p. 505). In other words, the category of nerd can be a social identity, and because the label nerd is feared, it appears to be devalued. Here I propose that to avoid being stigmatized as a nerd, women may be underperforming on math tests.

The current research will examine whether this fear of being labeled a nerd can cause similar underperformance in women's math performance as stereotype threat. To my knowledge, there has not been any research comparing women's math performance under conditions of stereotype threat and nerd stigma avoidance. In addition, although there have been a few correlational studies examining women's math performance and the nerd identity, to my knowledge, none have examined the causal effects of nerd stigmatization on women's math performance. This study will contribute to the research on the gender gap in mathematics performance because it may provide another explanation as to why women are not performing as well as men in mathematics. Also, this research may provide new grounds for future researchers to find ways to eliminate the nerd stigma and decrease the gender gap in math performance. Below the stereotype threat and stigma research is reviewed more thoroughly.

Stereotype Threat

Ever since Steele and Aronson introduced the term stereotype threat in 1995, their article has been cited over 3,000 times on scholar.google.com (Steele & Aronson, 1995). Their original research showed that African American participants performed worse, compared to White participants, on a verbal exam when primed with being tested on their verbal abilities. When African American participants were led to believe that their performance was unrelated to ability, they performed similarly as White participants. Steele and Anderson's initial study led to numerous experiments not only replicating their findings but expanding it to other stereotyped

identities as well. For example, stereotype threat has been found to occur in women when women are compared to men in mathematical abilities (Spencer et al., 1999), in Whites when Whites are compared to Asians in mathematical abilities (Aronson et al., 1999) and in White men when White men are compared to Black men in athletic abilities (Stone, Lynch, Sjomeling, & Darley, 1999). Stereotype threat is not confined to a specific race, gender, or ability. The phenomenon of unintentionally decreasing performance out of fear of confirming a negative stereotype is so counterintuitive that it is not surprising to see why Steele and Aronson's (1995) findings sparked such an expansive amount of research in stereotype threat.

One area of research that stereotype threat has greatly influenced is the research on women's math performance. Spencer et al. (1999) found that female participants performed significantly worse on a difficult math test when they were told that the math test had shown gender differences in math abilities than female participants who were told the test had not shown gender differences in math abilities. The direction of the gender difference was not specified. When female participants were informed the test had no gender differences in math abilities, they performed similarly as men on a difficult math test. Furthermore, this underperformance only occurred when women were tasked with a difficult math test but not an easy math test (Spencer et al., 1999). Thus, women may perform well during a class math test that is relatively easier than the SAT math test; but when they are reminded about the stereotype that men are better at math than women, they perform worse on a difficult math test.

Although Spencer et al. (1999) also found that female participants in the control condition (where participants were given no information about gender differences on the test) performed worse on the math test than female participants in the no gender differences condition and male participants in both the control and no gender differences condition, other stereotype threat studies have found that different variables within that test taking environment may be reminding participants about the math performance stereotype. For example, studies have found that stereotype threat effects can lead to a decrease in women math performance

when women simply checked their gender before a math test (Rydell, McConnell, & Beilock, 2009), were the minority gender in the room (Inzlicht & Ben-zeev, 2000), or were in coed schools compared to an all-girls school (Picho & Stephens, 2012). However, simply telling female participants that the test does not show any gender differences is enough to buffer stereotype threat (Spencer et al., 1999). Although the stereotype threat literature has found several conditions on how and when this gender gap in mathematics performance occurs, some recent meta-analyses on previous stereotype threat literature with gender gap in mathematics performance suggests that the results are not as robust as originally believed.

About half of the stereotype threat studies Stoet and Geary (2012) examined did not show any effect of stereotype threat on women's math performance. This research was conducted by first finding all replications of the original study on gender differences in mathematics performance by Spencer et al. (1999). By examining all the studies that cited Spencer et al.'s original publication, Stoet and Geary (2012) found 23 articles that met their criteria (both men and women were tested, a math test was used, participants were recruited regardless of preexisting beliefs about the gender stereotype, participants were randomly assigned to two different stereotype threat conditions, and the study didn't explicitly state it is not a replication of the original study) to be a replication of the original study. Because the original study used college participants, three of the studies with participants under 18 were removed from analyses. Of the 20 remaining articles, only 11 (55%) successfully replicated the original study by finding a significant interaction ($p < .05$) between gender and stereotype threat with women performing significantly worse in the threat than in the no-threat condition (Stoet & Geary, 2012). Furthermore, Stoet and Geary (2012) argued since Spencer et al. (1999) did not adjust for mathematical scores in their analysis, the studies using adjusted scores (using any preexisting math scores such as SAT as a covariate) should not be included. Stoet and Geary (2012) found that now only 3 out of 10 (30%) articles replicated the original result. Their meta-analysis of the stereotype threat effect on women, using data sets from 19 of the 20 studies

mentioned earlier, showed that “adjustment” was a moderator to the stereotype threat effect, where only the studies with adjusted math scores showed the stereotype threat effect (estimated mean effect size ± 1 SEM; -0.61 ± 0.11 , $p < .001$) but not with studies using unadjusted math scores ($-.017 \pm .10$, $p = .09$) (Stoet & Geary, 2012, p. 97). This shows that the stereotype threat effect on gender performance may not be as supported with replication studies as many believed.

Although Ganley, Mingle, Ryan, Ryan, Vasilyeva, and Perry (2013) did not run a statistical meta-analysis, they did qualitatively compile a list of studies that examined the stereotype threat effect on gender performance with children and adolescence. Since the 12 studies Ganley et al. (2013) examined included those comparing men and women or only women, they made two criteria for the studies to qualify as showing stereotype threat effects: all studies had to show a significant ($p < .05$) difference between girls in the stereotype threat condition and girls in a no-threat condition and for studies involving boys and girls, there also had to be a significant interaction between gender and stereotype threat condition. Since many of the articles identified had multiple studies that examined several age groups, Ganley et al. (2013) separated them into four different groups, participants from: early elementary school, upper elementary school, middle school, and high school. While only three out of six studies with early elementary school students showed a stereotype threat effect, none of the nine studies with upper elementary school students found stereotype threat effect (Ganley et al., 2013). Yet, the stereotype threat effect reappeared with middle school students where four out of ten studies showed a stereotype threat effect. Although only two of the eleven studies with high school students showed a stereotype threat effect, the stereotype threat effect did not disappear again as it did in the upper elementary school studies after stereotype threat effect were found with early elementary school students (Ganley et al., 2013). Ganley et al.’s (2013) compilation suggests that the stereotype threat effect for gender performance may begin around

middle school but may occur in more specific conditions for high school students. Nevertheless, more than half of the studies in each group did not show a stereotype threat effect.

Finally, Picho, Rodriguez, and Finnie (2013) even found a trend that women in countries with less gender inequity (such as political, economic, education, and health differences) showed greater performance on a math exam when under stereotype threat conditions compared to women in countries with a larger gap in gender inequality. These meta-analyses indicate that perhaps there are other factors beyond stereotype threat effects to explain the gender gap in mathematics that need to be identified.

Stigma

Research on social stigma was greatly inspired by Erving Goffman when he published his book on stigma in 1974. Although Goffman used the term stigma to refer to a discrediting attribute, the resultant research done on the topic has led to many changes to the definition. Crocker et al. (1998) specified stigma only applies to attributes associated with a negative social identity and Link and Phelan (2001) stated that stigmas have multiple components working together and emphasized that economic, political, or social power must exist for a stigma to be effective. Even though the stigma concept can be vague and varies in definition from one stigma researcher to another, all of the definitions appear to indicate that stigma is some type of label that is often perceived as being negatively different from the norm. An individual bearing the stigma is typically referred to as stigmatized (Goffman, 1974). Those that do not bear the stigma are often referred to as “normals” or if they are stigmatizing another individual, “stigmatizers” (Goffman, 1974).

According to Goffman (1974), there are three different types of stigma: physical deformities such as scars, blemishes of individual characteristics such as dishonesty, or tribal stigmas such as race that are inherited. Stigma against the female gender most closely fits into Goffman's (1974) tribal stigma type because similar to race, sex is inherited; the nerd stigma most closely fits into the blemishes of individual characteristic type of stigma because typically a

list of individual characteristics are used to identify whether or not an individual is a nerd. It is very important to distinguish between the three stigmas because Crocker et al. (1998) argue that the visibility and controllability of the stigma are critical factors in understanding how individuals experience being stigmatized. Whereas physical deformities and tribal stigmas are more visible stigmas that are difficult or impossible to hide, individual characteristic stigmas can often be concealed and allow the stigmatized individual to avoid being judged while interacting with others. This is not to say that those with concealable stigmas will not be discredited though (Goffman, 1974). Individuals with concealable stigmas are still aware that if their devalued characteristics are discovered, they can be stigmatized (Crocker et al., 1998).

In fact, Pinel (1999) argued that the extent an individual expects to be stereotyped is variable, what she termed stigma consciousness. Pinel (1999) developed a reliable and valid measure to detect stigma consciousness by showing how self-conscious an individual is about their stigmatized status. It was found that there was a tendency for women high in stigma consciousness to avoid male relevant topics compared to women low in stigma consciousness (Pinel, 1999). This suggests that individuals high in stigma consciousness may also avoid other things like nerd like behaviors. In another study, Brown and Pinel (2003) found that when female participants were under conditions of stereotype threat, those who were high in stigma consciousness scored worse on a math test than female participants who were low in stigma consciousness. Hence, it was suggested that being highly conscious about being stigmatized may have led these individuals to be vulnerable to the stereotype threat effects (Brown & Pinel, 2003). Although Brown and Pinel (2003) found this effect with a visible stigma (female gender), the difference in math performance due to different levels of stigma consciousness suggests that being self-conscious about a concealable stigma may also lead the individual open to being stigmatized. The results found in Brown and Pinel's (2003) study follows why Crocker et al. (1998) argued that controllability is important in understanding individuals with stigmas.

A stigma is controllable when the stigmatized individual can change or eliminate the trait (Crocker et al., 1998). While many physical deformities or tribal stigmas are fixed and cannot be changed by the stigmatized individual, blemishes of individual characteristics can often be controlled by the individual. Crocker et al. (1998) argues that individuals with controllable stigmas are often more disliked, rejected, and harshly treated than individuals with uncontrollable stigmas. This may be because the stigmatizer puts less blame on an individual with uncontrollable stigma since the stigmatized individual cannot do anything to change it (Crocker et al., 1998). On the other hand, an individual with a controllable stigma is perceived as more blame-worthy. The ability for the stigmatizer to reject or harshly treat an individual with a stigma indicates that the stigmatizer may have some sort of social power over the stigmatized.

Link and Phelan (2001) argued that power is critical for stigmatization to occur. According to the authors, stigma is the co-occurrence of four components: labeling, stereotyping, separation, and status loss and discrimination (Link & Phelan, 2001). Even if all four components are occurring, without power (either social, political, cultural, or economic), a potential stigmatizer will not be able to enforce their criticism towards the stigmatized individual (Link & Phelan, 2001). The important role Link and Phelan (2001) put on power implies that the more power a stigmatizer holds, the more detrimental the effects can be for a stigmatized individual. Although we may encounter various degrees of social, political, cultural, or economic power in our everyday lives, social power is a very influential power that students may face in their academic career. As explained below with the nerd stigma, adolescent's behaviors are greatly affected by their peers; this may be because their peers have the most social power to stigmatize them.

Nerd stigma. The term nerd is often associated with a set of behaviors, such as wearing eyeglasses with thick lenses or studying in the library on weekend nights. Thus by avoiding engaging in these behaviors, an individual can hide from being stigmatized as a nerd (Bossson et al., 2005). High school students reported being a nerd in middle school but becoming normal

in high school (Kinney, 1993). Since the nerd stigma is both concealable and controllable, this explains why Rentzsch et al. (2011) found that individuals with good grades feared being labeled a nerd. These individuals are highly conscious that they can be stigmatized for getting good grades and since they can control their academic habits and abilities, they fear that they may be criticized for behaving in accordance with the stigma and be labeled a nerd.

Whereas stereotype threat research on the gender gap in math performance focuses on the stereotype that men are better at math than women, stigma research can include various other negative perceptions that women may face. Since an individual can be stigmatized for more than one characteristic that they possess, the context of the situation is very important in determining which stigma is elicited (Crocker et al., 1998). For example, a nerdy woman with a scar on her forehead may face all three types of stigma that Goffman (1974) described. The scar is a physical defect, nerdy is a blemished characteristic, and woman is a tribal stigma. The stigma that is most pervasive depends on the social context (Crocker et al., 1998). This may be why much of the literature on the nerd label is situated in academic settings.

Following Link and Phelan's (2001) concept of stigma, one can better understand why the nerd stigma is found mostly in school environments. As previously mentioned, Link and Phelan (2001) argue that stigma is the co-occurrence of labeling, stereotyping, separation, and status loss and discrimination. Most importantly, power must be exercised in order for stigmatization to occur (Link & Phelan, 2001). In any setting, it is typical to label because it allows differentiation of groups (Link & Phelan, 2001). Although individuals are primarily supposed to attend schools to learn and increase their intellectual abilities, school also serves many other functions for students, such as gaining social status and improving athletic abilities. Thus it is not surprising to see that individuals with higher intelligence are grouped into separate labels such as nerds. This nerd label is also linked to undesirable characteristics that form a stereotype about nerds. Even though individuals may be labeled a nerd because of their higher intelligence, they are also associated with negative characteristics such as non-athletic abilities

that the nerd stereotype is associated with. By using the label nerd, it also allows a separation between “us” and “them,” (Link & Phelan, 2001) such that only the nerds (“them”) have those negative traits and we (“us”) do not possess those characteristics. Those in the “them” category are often seen as less than human and are often viewed as “being” the label (Link & Phelan, 2001). The separation component allows those labeled as nerd to be further devalued because of the negative stereotypes and leads them to be viewed as less important in the eyes of the stigmatizer. This also makes it easier for nerds to be discriminated against because they are put into a different category than everyone else. The combination of the four components can be seen in an interview conducted by Heather Mendick (2005) among a group of students talking about other boys in their class. The group has already gone through the first component of labeling these boys as “good in math” and “nerds”:

- AJ: Do you think socially they're lower?
 Maryam: Yes [she laughs].
 AJ: Because... they're really fast in math and everything, but they have no social skills whatsoever.
 Imran: It's true. That's true.
 Maryam: That's true, actually, I'd rather be like medium stage in math, and have social skills. I wouldn't want to be like them. (p. 214)

Stereotypes came in when they associated the boys as also having no social skills. Both math skills and lack of social skills are two undesirable characteristics in the stereotype about nerds. Imran's agreement with AJ's previous statement “It's true. That's true” indicates that the “no social skills” portion was not previously mentioned. It was brought up by AJ as a stereotype for the label they've attached to the boys they are speaking about. The separation between “us” and “them” can be seen by the last speaker quoting that they “wouldn't want to be like them.” The last component of status loss and discrimination is seen in the beginning of the excerpt with Maryam agreeing to AJ's question that the other boys are socially lower.

However, these four components of stigma would not have an effect unless there is a sense of power to stigmatize. Power can include political, social, or economic power and is critical to stigma (Link & Phelan, 2001). The stigmatizer needs to have some power to facilitate

stigma to occur if all four components mentioned above exist. In an academic setting, the label nerd has more power because individuals are more likely to be judged based on academic abilities. But in the environment outside of an academic setting, the power is lost since academic intelligence is less relevant.

Research on social stigmas show that there are other explanations as to why women may show an underperformance in math. In a study with high school students, Park, Young, Troisi, and Pinkus (2011) found that female participants were less likely to prefer majoring in math or science if they were primed with images or conversations relating to romantic goals compared to female participants primed with an intelligence goal. In fact, there was a high negative correlation between female participant's engagement in math activities and pursuit of romantic activities (Park et al., 2011). The more female participants engaged in math, the less they pursued romantic activities. In fact, Park et al. (2011) also found that the more math activities female participants engaged in, the less desirable they felt. Not surprisingly, unattractiveness is also one of the characteristics used to describe nerds. Although appearing unattractive does not necessarily make them a nerd, women may feel that they will be misclassified as such.

Beck (1963) stated that performing certain role violating behaviors can make a normal individual feel more at risk in being misclassified (as cited in Bosson, Prewitt-Freilino, & Taylor, 2005). In one study by Bosson, Weaver, and Prewitt-Freilino (2012), participants were asked to imagine performing nerd behaviors such as joining a computer programming group or studying in the library on weekend nights and rated the likelihood that others who saw this behavior would assume they were a nerd. Regardless of whether or not the participant self-identified as a nerd, participants believed that observers would very likely classify them as nerd. In fact, in another similar study, participants who completed similar procedures as Bosson et al. (2012)'s study and expected to get classified as a nerd by their peers reacted more negatively towards performing nerd-like behaviors in public (Bosson et al., 2005). In other words, the participants

rated that they were less likely to perform those nerd-like behaviors in public if they believed performing those behaviors can result in their peers classifying them as a nerd. Thus, math activities can be a role violating behavior to being romantically attractive, and lead women to believe that they may be wrongly viewed as unattractive and classified as a nerd.

If engaging in trivial math activities such as completing a math assignment or paying attention in their math class can lead to feelings of identity misclassification and negative reactions to performing identity like behaviors, a more important activity such as the SAT can elicit similar and perhaps even stronger negative reactions. Therefore it is hypothesized that women may expect to be misclassified as a nerd if they perform well on the SAT, so they may react negatively by scoring low on the test, providing another explanation as to why there is such a large SAT score difference between men and women.

Consistent with the growing stereotype threat literature that suggests the gender gap in mathematics may emerge around middle school (Cvencek, Meltzoff, & Greenwald, 2011, Ganley et al., 2013, & Picho et al., 2013), middle school girls are the primary victims of peer pressure (Boehnke, 2008). By eighth grade, popular students believed that high achieving students should claim to have studied less whereas popular seventh grade students suggested honesty from their peers (Zook & Russotti, 2012). When comparing boys' math performance to girl's math performance, Boehnke (2008) found that there was a high correlation for girls with high academic abilities combined with a high fear of social exclusion to perform worse in math. Similar results were found in high school students (Rentszch, et al., 2011). Since a higher correlation was found with female participants than male participants, this suggests that women are more negatively affected by fear of social exclusion than men. Rentszch et al. (2011) found that not only were high achieving students who put a lot of effort into school generally less liked by their peers, but they also received negative rating when they displayed pride about good grades. As previously mentioned, high achieving students were also more likely to fear being labeled a nerd (Rentszch et al., 2011). Thus, women may engage in less math activities and

perform worse on a math test because they fear that behaving otherwise may lead them to be stigmatized as a nerd.

Stigma, Stereotype Threat, and Stereotype Boost

Although stigma can seem similar to stereotype threat in that both terms indicate a negative view towards a group or person, they are quite different from each other. As the name references, stereotype threat is associated with stereotypes, or more specifically negative stereotypes. Stereotypes are shared general beliefs that a group has a certain characteristic (McGarty, Yzerbyt, & Spears, 2002). Stigmas, on the other hand, are labels of unwanted characteristics. Thus, a stereotype can be formed from one or more stigmas. A stereotype about nerds is that they are very smart, socially awkward, unattractive, and clumsy or nonathletic. When an individual is called a nerd, that individual is believed to have those “nerd” characteristics even though they may or may not have them. When an individual is stigmatized to be a nerd, they are perceived to have one or more of those characteristics. Even though being smart is not an unwanted characteristic, its association with the other three negative characteristics stereotyped to exist in the nerd group may put individuals that are smart into the same stigmatized group. A big difference between stigmas and stereotype threat is that a stigma is a label or term that is perceived to be negative whereas stereotype threat is an effect of a negative stereotype. For example, for nerds, stereotype threat occurs if an individual identifying with being a nerd is clumsier when being primed that nerds are clumsy. This will confirm the negative stereotype that nerds are clumsy. The negative characteristics mentioned above for nerds are generally associated with the term nerds, thus making it a stigma. Since this study will examine whether or not the fear of being stigmatized as a nerd will decrease math performance, the participants may or may not identify as being a nerd. Stereotype threat, on the other hand, is a threat to a group that the individual belongs to. Thus, the portion of this study that will be looking at the nerd concept is different from stereotype threat.

Stereotype boost is the exposure to a positive stereotype about an in-group that can lead to a performance boost (Shih, Pittinsky, & Ho, 2012). Shih et al. (2012) explains that stereotype boost theory runs parallel to stereotype threat theory in that the former theory involves a negative stereotype that hurts performance whereas the latter theory involves a positive stereotype that improves performance. A similarity between the two theories is that they are based on a stereotype about one's in-group. Although the term stereotype boost is relatively new, additional evidence for stereotype boost effects are found in previous stereotype research. For example, in a study with the elderly, Levy (1996) tested participants memory performance before and after a priming intervention (positive or negative stereotype) and found that when the elderly participants were implicitly primed with positive stereotypes about the aging, their memory performance improved more than individuals primed with negative stereotypes about the aging.

One study on stereotype susceptibility examined how Asian American women performed on a quantitative test when their ethnic identity was activated versus when their gender identity was activated (Shih, Pittinsky, & Ambady, 1999). While stereotypes hold that Asians have superior math skills than other ethnic groups, women are stereotyped to have worse math skills compared to men. Shih et al. (1999) found that when ethnic identity was activated, Asian American female participants performed better than when Asian identity was not activated. Thus the positive stereotype about their Asian identity appears to improve, or boost, their math performance. According to Shih et al. (2002), research on stereotype boost so far has shown that one critical factor for performance to boost is that the stereotype is subtly activated. It has been found that when a positive stereotype is subtly activated, it boosts the individual's performance but not when the stereotype was blatantly activated (Shih, Ambady, Richeson Fujita, & Gray, 2002). More interestingly, when the positive stereotype was blatantly activated, participants showed a significantly lower performance compared to participants in the control condition (Cheryan & Bodenhausen, 2000). This suggests that a positive stereotype needs to

be primed subtly in order to increase performance; otherwise it can lead to negative effects. An explanation for this effect is that a blatant prime can increase the pressure for participants to have to “live up to social expectations and represent his or her group” (Shih et al., 2012, p. 144). So with a subtle prime, the participant is relieved of this added pressure when the individual is explicitly unaware of the positive stereotype (Shih et al., 2012). Stereotype boost is relevant to the proposed research because we believe certain participants may experience a boost in performance. More specifically, since intelligence is a positive quality, we predict participants who identify as being a nerd will perform better on an academic test than individuals who fear being labeled a nerd and do not identify as being a nerd.

Summary and Overview of Current Study

Since the concept nerd can vary in different cultures and situations, this research will use the same characteristics that Rentzsch et al. (2011) used to define the label nerd. Rentzsch et al. (2011) argue that the label nerd includes characteristics such as being ambitious, intelligent, having good grades, studying a lot, displaying success publicly, being shy, having few friends, not wearing fashionable clothes, not being athletic, and not being physically attractive. Although Rentzsch et al. (2011) are from Germany, we believe that these characteristics closely resemble how individuals in the United States also view nerds. In fact, a recent linguistic study on the characterization of the main “nerd” in *The Big Bang Theory*, a current popular television sitcom in the United States, by an Australian researcher compiled a list of traits that they argue Western audiences associate geeks and nerds as having (Bednarek, 2012). All the characteristics Rentzsch et al. (2011) referenced above, except for having good grades and displaying success publicly, were referenced in Bednarek’s (2012) list.

Even though the label nerd has positive characteristics such as intelligent, having good grades, and being ambitious, Rentzsch et al. (2011) states that it is still one of the least liked crowds at school. These positive attributes may actually be viewed as negative characteristics by a stigmatizer. In an interview with high school students, Kinney (1993) found that many of

the statements concerned all of the hard work “nerds” put into getting good grades, leading them to having less time for a social life. One student even went as far as claiming that nerds have a “screwed-up value system” because all they do is study (Kinney, 1993). According to a study with multiple high school students, one of the stereotypes about nerds is that they are competitive about grades (Bishop et al., 2004). Interestingly, being smart was acceptable among their peers, but not when the good student is trying to get good grades (Bishop et al., 2004). Together, these findings support Rentzsch et al.’s (2011) finding that effort is devalued.

Since these labels of nerds, jocks, cheerleaders, and goths still continue to exist in high school settings (Bishop et al., 2004), women may fear that doing well on the SAT will lead them to be stigmatized as being a nerd. While women can simply avoid taking the SAT math test to avoid being stigmatized as being a nerd, the SAT is a relatively important component in a college application. Thus, taking the SAT is still an obstacle women (who fear being stigmatized as a nerd) would need to overcome if they want to attend college. This fear has been demonstrated when simply imagining nerd like behaviors led many participants to expect a high likelihood of being classified as a nerd by observers (Bosson et al., 2012). In addition, expecting to be classified as a nerd led to more negative reactions towards performing nerd like behaviors (Bosson et al., 2005), suggesting that women may be performing worse on a math exam to avoid being associated with the stigma.

Since the reviewed research shows that peer pressure and labels can significantly influence academic performance combined with the fact that high SAT scores and outstanding grades are becoming increasingly important for a high school student’s college application, it is vital to examine how much peer pressure and labels impact academic performance such as on a math test. In the current study, it is proposed that this fear of being labeled a nerd can cause similar, if not greater, underperformance on a math test for women as stereotype threat.

Although there is a limited amount of research on nerds, the combination of studies in areas such as stereotype threat, social stigma, and nerds shows that being labeled a nerd may

have a significant effect on women's math performance. Findings from this proposed research can not only help identify why women are performing worse in math, but it may spillover to other noted gender gaps. The effects found in stereotype threat research in relation to the underperformance of women in math tasks have often been associated with why there are so few women in Science, Technology, Engineering, and Math (STEM) fields. If the proposed findings of the current research are supported, the nerd stigma may also help explain why there is a gender gap in STEM fields. The devaluing of effort shows that women may shy away from taking courses in STEM majors because of the effort they would need to exert in these classes. As mentioned above, women were less likely to show interest in math and science majors when they were primed with romantic goals and engaging in math activities made them feel less attractive (Park et al., 2011), a characteristic that is associated with being a nerd. This shows that having a STEM career may lead women to believe that they are unattractive and ultimately misclassified as being a nerd by others. The fear of being misclassified may help explain why even high math and high verbal ability women are more likely to choose non-STEM fields than women with high math but moderate verbal abilities (Wang, Eccles, & Kenny, 2013). When these high ability women had a choice, they chose careers that are less likely to get them stigmatized as nerds. As previously mentioned, power allowed the nerd stigma to be significant in academic settings. If the nerd stigma does exist, it is possible that it expands to outside the academic realm and affects women's career choices. Thus, this research will not only expand our knowledge regarding social stigma and the gender gap in math performance, but it will have implications for STEM fields as well.

Hypotheses

The current study's hypotheses are as follow:

1. Male and female participants exposed to the nerd stigma will perform worse on a mathematics exam compared to male and female participants not exposed to the nerd stigma. Research on stigma suggests that individuals with controllable stigmas are

often treated worse than individuals with uncontrollable stigmas (Crocker et al., 1998). In addition, simply imagining performing nerd behaviors was enough to lead individuals to incorrectly believe that others would incorrectly identify them as a nerd (Bosson et al., 2012). Exposing participants to the nerd stigma can lead to similar identity misclassification. Thus participants exposed to a controllable stigma such as the nerd stigma will be more at risk in believing that they will be devalued by others compared to participants not exposed to the nerd stigma.

- a. Female participants will be negatively affected by the nerd stigma more than will male participants because girls are found to be more likely to suffer peer pressure and have a greater fear of social exclusion (Boehnke, 2008). Women have more incentive to avoid being stigmatized as a nerd by their peers, and thus will perform worse on the test than men.
- b. Female participants in the nerd stigma group and the gender stereotype group will score lower on the math exam compared to female participants in the no stereotype control group. Since the proposed study will be conducted in a similar manner as previous gender stereotype threat research, similar effects of lower performance are expected in the gender stereotype group when compared to the no stereotype control group. Female participants in the nerd stigma group will show lower math performance compared to the no stereotype control group. This follows the argument presented earlier that participants exposed to the nerd stigma may incorrectly believe they will be perceived as a nerd and be rejected by others, and women are more likely to want to avoid being stigmatized as a nerd. Female participants exposed to the nerd stigma will have the additive negative effects of being both a woman and exposed to the nerd stigma.
- c. Female participants in the nerd stigma group will score at lower or similar levels as female participants in the gender stereotype group. In reflection of the meta-

analyses on previous stereotype threat research, the inability for some studies to replicate the effect indicates that gender stereotype threat may not be a stable explanation to the gender gap in math. The research on student's negative perception and women's reaction to the nerd label suggest that the nerd stigma will have a similar or greater negative effect on female's math performance than the gender stereotype.

2. The effect of the nerd stigma will be moderated by nerd identification. Following the literature on stereotype boost, participants high in nerd identity will exhibit a higher performance on a mathematics exam when exposed to the nerd stigma condition compared to participants in the no stereotype control group. It is also predicted that participants in the nerd stigma condition with lower nerd identity will perform similarly on the math test as participants with lower nerd identity in the no stereotype control group.
3. The effect of the nerd stigma will be moderated by gender identification in female participants. Park et al. (2011) argued that romantic scripts encourage women to be more feminine and found that the more math activities female participants engaged in, the less attractive they felt. This suggests that math activities make women feel less feminine. Female participants in the nerd stigma condition who score high in gender identity will seek to maintain their feminine identity (Schmader, 2002), and thus perform lower on a mathematics exam compared to female participants high in gender identity in the control condition. It is expected that female participants in the nerd stigma condition who score lower in gender identity will be buffered from the nerd stigma effects and thus perform as well on the math test as female participants low in gender identity in the control condition.
4. The effect of the nerd stigma will be moderated by fear of social exclusion in female participants. Brown and Pinel (2003) found that female participants highly conscious about the female stigma scored worse on a math test under stereotype threat

conditions compared to female participants low in stigma consciousness. Since fear of social exclusion is used to access the fear an individual has to being called a nerd, female participants who score high in fear of social exclusion must logically be aware of the nerd stigma. Thus, it is predicted that female participants in the nerd stigma condition who score higher in fear of social exclusion will perform lower on a mathematics exam compared to female participants in the control condition. But, it is expected that female participants in the nerd stigma condition who score lower in fear of social exclusion will be buffered from the nerd stigma effects and perform as well as female participants in the control condition .

5. The effect of the nerd stigma on math performance will be mediated by fear of social exclusion in female participants. The more female participants fear being socially excluded, the less they would want to be associated with being a nerd. Thus, it is expected that to avoid being labeled a nerd, female participants will exhibit lower performance on the math exam. It is predicted that female participants in the nerd stigma condition will exhibit a lower performance on the mathematics exam via their rate of fear of social exclusion.

CHAPTER 2

METHODS

Design

This study was a 2 (Gender: male vs. female) X 3 (Condition: no stereotype vs. gender stereotype vs. nerd stigma) between-subjects experiment. This design was chosen so that the presence of gender stereotype threat effects could be established by comparing mathematical scores in the no stereotype and gender stereotype condition. Including a stereotype threat condition also allowed for a comparison between stereotype threat effects and nerd stigma effects. Including the no stereotype (control) condition served to increase internal validity by comparing female participants in the stereotype threat condition to female participants in the control condition (similar to those in previous stereotype threat research with a control condition (Spencer et al., 1999)). Male participants were included to test the hypothesis that female participants in the gender stereotype condition would perform worse than male participants in both gender stereotype and no stereotype (control) conditions and female participants in the control condition. Although recent gender stereotype threat research has used mostly female participants to examine the gender gap in mathematics performance because male participants were not negatively affected by the gender stereotype (Spencer et al., 1999), another reason to include male participants was because of the new nerd stigma concept. The inclusion of men increased external validity for the nerd stigma by showing whether or not the nerd stigma also affects male participants. If the nerd stigma does negatively affect men, it would help test whether or not the nerd stigma effects differs from the gender stereotype threat effects. The differentiation between the effects for nerd stigma and gender stereotype threat would allow a better comparison between the two theories as a whole and not just their effects on women.

In order to ensure that the possible participants at Georgia Southern University were aware that there was a stereotype about nerd's academic abilities and a stereotype that men and women differ in mathematical abilities, a preliminary survey about stereotype awareness

was distributed to undergraduate introductory social psychology classes. Out of 63 undergraduate students, 57 (90.5%) agreed that people in general have the stereotype about nerds and 53 (84%) agreed that people in general have stereotypes that there are gender differences in mathematical abilities. Although this sample was not representative of the entire university, these results suggest that many students at Georgia Southern University are aware of both stereotypes examined in the current study.

Participants

One hundred and fifty three undergraduate students participated in the study. Participants were recruited through the online SONA system from Georgia Southern University's undergraduate psychology courses to participate in this research for class credit or extra credit. Three participants were removed from the analyses because one participant recognized the individual in the picture manipulation, another participant received the wrong manipulation (a female participant received the male manipulation version and saw a male nerd picture instead of a female nerd picture), and the third participant was under the age of 18. Thus, data from 150 participants, 90 women (60%) and 60 men (40%), were used in the analyses. The average age of the participants was 20.25 years ($SD = 3.98$). The sample included 80 White/European, 60 Black, 3 Hispanic, 2 Asian, and 5 participants who indicated Other as race.

Materials and Measures

Math exam. The math test consisted of 30 questions and the participants had 20 minutes to complete the test. The math test consisted of the same questions that another researcher had used and was successful in finding a stereotype threat effect (Jamieson & Harkin, 2011). Although Jamieson and Harkin (2011)'s stereotype threat manipulation was not used for this study, using the same math test was thought to be beneficial. It was reasoned that if stereotype threat was found in the current study, it would provide a more accurate comparison between the gender stereotype condition and the proposed nerd stigma condition. Since the math exam was taken from a previous researcher's study, the tests were scored similarly. The

sample math questions used were scored as the number correct. Thus, no punishment was given for guessing or leaving questions blank. See Appendix A for a copy of the math exam.

Pictures. Pictures were used for the gender stereotype and nerd stigma conditions. Four individuals (2 men and 2 women) were recruited to have a picture of them taken for the gender stereotype condition and the nerd stigma condition. A preliminary survey was distributed to a psychology class in the spring of 2013 to obtain descriptions about the appearance of nerds and non-nerds. These responses were used to create the criteria set for the men and women in each condition. The female gender stereotype condition reflected a woman wearing makeup, stylized hair, no glasses, and a stylized shirt. The male gender stereotype condition reflected a man with no glasses, had stylized hair, and wore a loose shirt. The woman in the nerd stigma condition had no makeup, plain un-stylized hair, wore thick rim glasses, and wore a plain t-shirt. The man in the nerd stigma condition wore thick rim glasses, had gelled, neat hair parted to the side, and wore a neat, button up, tight fitting shirt. A total of 8 pictures were taken: Female 1 in gender condition, Female 1 in nerd condition, Female 2 in gender condition, Female 2 in nerd condition, Male 1 in gender condition, Male 1 in nerd condition, Male 2 in gender condition, and Male 2 in nerd condition. Refer to Appendix B for the pictures.

The female nerd pictures were verified by pilot participants as looking like nerds and the female gendered pictures were verified by pilot participants as not looking like nerds. The pilot study also indicated that the two women did not differ in perceived attractiveness, masculinity, or femininity. Similarly, the male nerd pictures were verified by pilot participants as looking like nerds and the male gendered pictures were verified by pilot participants as not looking like nerds. The pilot study also indicated that the two men did not differ in perceived attractiveness, masculinity, or femininity. Since images and pictures have been used in previous stereotype threat literature to successfully elicit stereotype threat effects in women, using these pictures was warranted (Good, Woodzicka, & Wingfield, 2010; Muzzatti & Agnoli, 2007, & Neuville &

Croizet, 2007).

Fear of social exclusion. The fear of social exclusion questionnaire was based on the question Boehnke (2008) used to ask participants if they fear being called a nerd. Instead of using Boehnke's (2008) one question on a 4 point Likert scale (1 = never to 4 = frequent), the question was slightly changed so that participants could respond with a 6 point Likert scale (1 = strongly disagree to 6 = strongly agree). This allowed participants more flexibility in associating their fear. Using the same 6 point Likert scale, three additional questions were created: "I do not want to be labeled as a nerd," "I try to not look nerdy", and "I am comfortable being labeled a nerd" (reverse scored). The three questions were included to get a better idea of how participants felt about the nerd label. The participant's responses were averaged, with a higher score indicating greater fear of social exclusion. See Appendix C for the questions. Reliability analysis showed a Cronbach's alpha of .67 for all four items in the current sample.

Peer crowd. The peer crowd questionnaire was adapted from the one used by La Greca and Harrison (2005). Using the peer crowds from La Greca and Harrison (2005)'s questionnaire, participants were asked to think back to when they were in high school and indicate if those crowds were present at their school, to provide any alternate names or crowds that may have existed, and indicate how much they identified with each peer crowd with a 7 point Likert scale anchored with *strongly disagree* (1) and *strongly agree* (7). Participants also saw a second set of similar questions modified to ask participants to think about their time at Georgia Southern University. A copy of both peer crowd questionnaires can be seen in Appendix D. Both peer crowd questionnaires (high school version and Georgia Southern University version) were used to ensure that the label nerd was still used in high school and college settings and was familiar to the participant. In the current sample, 89.3% of the participants agreed that the nerd crowd existed in their high school and 86% agreed that the nerd crowd exists at Georgia Southern University. The participant's response to how much they identify with a nerd when they were in high school and at Georgia Southern University were

averaged to create a nerd identity scale. A higher score indicated more identification with the nerd group. Reliability analysis indicated a Cronbach's alpha of .72 for the two items in the current sample.

Gender identity. The gender identity questionnaire was a 4 item modified subscale of Luhtanen and Crocker's (1992) Collective Self-Esteem Scale. The scale was a modified version used by Schmader (2002) in a gender stereotype threat study. Since Luhtanen and Crocker's original scale was created to be adaptable for any specific social identity, modifications are not uncommon. In addition to Schmader (2002), Wout, Danso, Jackson, and Spencer (2008) also used the modified scale for a study looking at the gender stereotype threat effect. Brown and Pinel (2003) published a study on stigma and also modified the Collective Self-Esteem Scale. Both Brown and Pinel (2003) and Schamder (2002) used the scale as a measure of gender identification and had identical phrases for the items they modified, showing that although the scale was modified, it has been consistently used in two different studies. Following the two mentioned studies, Likert scales were anchored with *strongly disagree* (1) and *strongly agree* (7) (e.g., Brown & Pinel., 2003; Schmader, 2002). A sample item is "Being a man/woman is an important part of my self-image." The gender identity questionnaire was scored by reverse scoring the last two questions. Then, following Luhtanen and Crocker (1992)'s method to score the subscale, the scores on the four items was averaged to form an index of gender identification. The higher the index, the more the individual identifies with their gender. Refer to Appendix E for a copy of the gender identity questionnaire. Reliability analysis showed a Cronbach's alpha of .83 for all four items in the current sample.

Demographics. The demographics questionnaire included questions about the participants' sex, race, age, year in college, highest math course taken, the grade received in the course, if they took the math course in high school, college, or both, their total, math, and verbal SAT score, and their current and high school GPA. A copy of the demographics question can be seen in Appendix F.

Manipulation checks. Participants were asked whether or not they saw a picture to assess whether or not they were aware of the manipulation. If they did see a picture, they were asked to rate how nerdy, feminine, masculine, and attractive they perceived the individual in the picture. The picture ratings were used to test whether the pictures used for the gender stereotype condition were different from the pictures used for the nerd stigma condition and to examine whether there were any perceived differences between the two different volunteers in the same-gendered pictures. In the current sample, 42 of the participants either indicated they did not see a picture when they had been exposed to a picture or indicated they saw a picture when they were not exposed to a picture. Of the 42 participants who responded to the manipulation check question incorrectly, 15 were from the nerd stigma condition (8 women and 7 men), 26 were from the gender stereotype condition (19 women and 7 men), and one man from the control condition. During debriefing, some participants had asked questions about the manipulation check question about the picture. These participants indicated they were not aware that the question about the picture referred to the picture they saw earlier on the test. This suggests that participants saw the manipulation picture, but were unclear about the manipulation check question. Perhaps, participants may have thought there was supposed to be a picture on the manipulation check page and did not believe that the question was referring to the picture on the math instructions page. Since participants were given three minutes to view the picture, it was likely participants' misunderstanding of the manipulation check question, rather than a lack of seeing a picture, that led the 42 participants to answer the manipulation check incorrectly.

Since Spencer et al. (1999) found that gender stereotype threat only occurred when women were tasked with a difficult math test and not an easy math test, participants were asked to rate the difficulty of the test to ensure that participants perceived the test to be difficult. On a Likert-type scale anchoring from 1 (*very easy*) to 6 (*very difficult*), on average participants rated the math exam as 3.80 ($SD = 1.14$), leaning towards somewhat difficult. Analyzing the

responses by participant sex revealed that female participants rated the math exam as somewhat difficult ($M = 4.06$, $SD = 1.10$) and male participants rated the math exam as somewhat easy ($M = 3.41$, $SD = 1.01$). An independent t-test showed that female participants rated the math exam as more difficult than male participants, $t(146) = 3.53$, $p < .01$. Thus, female participants did perceive the math exam to be difficult. See Appendix G for a copy of the manipulation check questions

Procedures

First, participants came in to the lab in mixed gendered groups of 1 to 4 people and read an informed consent form. Participants were seated in their own cubicle and were separated from the other participants by partitions. Once participants signed the informed consent and accepted participation in the study, the experimenter told participants that they “will be answering some math questions to help standardize new items for the SAT” (a cover story so that participants were not aware of the study’s hypotheses). The experimenter explained that participants would have 20 minutes to complete 30 math questions and then asked participants to read the instructions for the math test to themselves. Participants were randomly assigned to one of three groups. Participants randomly assigned to the gender stereotype condition viewed a picture (on the math instructions page) of a same gender student taking a test before taking the math test. Participants randomly assigned to the nerd stigma condition viewed a picture (on the math instructions page) of a same gender student dressed as a nerd before taking the math test. The control group did not see any image (on the math instructions page) before completing the math test. Since the pictures were included on the second page of the test packet, the experimenter was blind to which condition the participant was in. The experimenter left the room for one minute while participants read the test instructions. In order to decrease any possible experimenter effects, the experimenter stayed in the room with the participant as little as possible. Next, the experimenter returned to the room and read the instructions aloud to the participant to ensure the directions were clear. After the experimenter asked the participants

to attempt the two practice problems on the bottom of the page, the experimenter left the room for two minutes. Since participants were asked to read the instructions and attempt the practice problems on the math instruction page, participants in the experimental conditions were exposed to the picture for at least three minutes. The experimenter then asked the participants to “correctly complete as many problems as you can in 20 minutes” and explained that there was no penalty for guessing on the math exam. Before leaving the room, the experimenter asked the participants to start on the math exam. After 20 minutes, the experimenter returned to the room and asked participants to stop working on the math test. Participants were then asked to proceed to the questionnaires. The questionnaires consisted of the two peer crowd questionnaires, the gender identity questionnaire, and the fear of social exclusion questionnaire. The orders of these questionnaires were randomized to control for any carryover or order effects. Finally, participants completed the demographics questions and manipulation check questions, were debriefed and thanked for their time.

CHAPTER 3

RESULTS

Preliminary Analyses

Experimenter effects. The two female experimenters that collected data differed by age and ethnicity. Specifically, one experimenter was a 23 year old White female and the other experimenter was a 27 year old Asian female. Thus, preliminary analyses were conducted to test for any experimenter effects on participants' math performance. For the current sample, a 2 (Experimenter: White vs. Asian) X 2 (Gender: male vs. female) by 3 (Condition: no stereotype vs. gender stereotype vs. nerd stigma) ANOVA on number of math questions correct revealed that the only significant effect was an interaction between experimenter and participant gender, $F(1,138) = 3.93, p = .05$. Follow-up simple effects tests showed that under the Asian experimenter, men ($M = 16.22, SD = 6.67$) performed significantly better on the math test than women ($M = 12.04, SD = 4.25$), $t(64) = -3.53, p < .01$. Male participants exposed to the Asian experimenter may have been motivated to perform better on the math test when exposed to the Asian stereotype that Asians are better at math than other races (Shih et al., 1999). Men ($M = 13.68, SD = 4.26$) and women ($M = 13.26, SD = 4.71$) scored similarly under the White experimenter, $t(51) = -.32, p = .75$. Female participants scored similarly under the Asian experimenter ($M = 12.04; SD = 4.25$) and the White experimenter ($M = 13.26; SD = 4.71$), $t(88) = -1.28, p = .21$. Thus it appears that the male participants were affected by the Experimenter, but the female participants were not affected by the Experimenter. Since the main hypotheses of this study apply to the female participants, Experimenter was not included in the remaining analyses. See Table 1 for results.

Table 1

Results for ANOVA on experimenter effects

Source	<i>df</i>	<i>F</i>	<i>p</i>	η^2
Experimenter	1	.32	.57	.00
Experimenter X Condition	2	.06	.95	.00
Experimenter X Gender	1	3.93	.05*	.28
Experimenter X Condition X Gender	2	.54	.59	.01
Error (Within groups)	138			

Note: * = $p \leq .05$.

Picture stimulus manipulation check. In both experimental conditions (gender stereotype, nerd stigma), two individual's pictures were randomly used for each condition. Using more than one picture for each condition helped to ensure that any effects found would not be dependent on one individual's appearance, but rather on the criteria set for each gender in the specific condition. Since the nerd pictures were used to activate the nerd stigma, it was vital to test whether the nerd picture was rated as more nerdy than the gendered pictures. As part of the manipulation check questions, participants rated the pictures on nerdiness, femininity, masculinity, and attractiveness on a 5 point Likert scale (1 = strongly disagree to 5 = strongly agree). As expected, results showed that both women in the nerd pictures ($M = 2.27$, $SD = 1.41$) were rated significantly more nerdy than the women in the gendered pictures ($M = 1.09$, $SD = 1.30$), $t(60) = -3.40$, $p < .01$. However, contrary to pilot testing results, the women in the nerd pictures were rated below the midpoint of the nerdiness scale whereas pilot female participants rated the women in the nerd pictures above the midpoint of the nerdiness scale ($M = 3.35$, $SD = 1.00$). Surprisingly, the men in the nerd pictures ($M = 2.21$, $SD = 1.83$) did not significantly differ from the men in the gendered pictures on appearing nerdy ($M = 1.74$, $SD = 1.37$), $t(33) = -.90$, $p = .38$, with both types of pictures being rated below the nerdiness scale midpoint. Pilot male participants not only rated the male nerd picture above the nerdiness scale

midpoint ($M = 3.56$, $SD = 1.05$), but also rated the men in the nerd pictures to be significantly more nerdy than the men in the gendered pictures, $t(70) = 5.94$, $p < .01$. Independent sample t -tests also showed that female participants did not perceive the women to differ in attractiveness, femininity, or masculinity, all p 's $> .05$. Male participants did not perceive the two men in the pictures to differ in attractiveness, femininity, or masculinity, all p 's $> .05$.

In conclusion, analyses on the picture stimulus revealed mixed results for the nerd stimuli. Although the results for the female nerd and gendered stimuli did support that the participants perceived the nerd pictures as more nerdy than the gendered pictures, the ratings of the nerd picture were below the nerdiness scale midpoint, possibly indicating a weaker than expected manipulation of the female nerd stigma. The results for the male nerd and gendered stimuli showed that both types of stimuli were rated low in nerdiness, again possibly indicating a weaker than expected manipulation of the male nerd stigma. Pilot participants saw the stimulus pictures and immediately rated the pictures on the dimensions of interest. The current participants did not rate the pictures until the end of the study. It's possible that a fading memory of the stimulus pictures affected the results of the manipulation checks.

Order effect check. The peer crowd, gender identity, and fear of social exclusion were randomly ordered to counterbalance any carryover effects. Analyses were conducted to ensure that there were no carryover effects. Results indicated that 85 (56.7%) completed the peer crowd questionnaire first, 34 (22.7%) completed the gender identity questionnaire first, and 31 (20.7%) completed the fear of social exclusion questionnaire first. Since more than half of the participants received the peer crowd questionnaire first, this suggests that the randomized procedures were not implemented by a research assistant when the questionnaires were collated. A closer examination showed that when participants responded to the peer crowd questionnaire (which was used to assess nerd identity) first, there was a significant negative correlation between nerd identity and gender identity ($r(78) = -.30$, $p = .01$) and between nerd identity and fear of social exclusion ($r(78) = -.25$, $p = .03$), but not between fear of social

exclusion and gender identity ($r(83) = .21, p = .06$). When participants responded to the peer crowd questions first, a higher score on nerd identity was associated with a lower score on both gender identity and fear of social exclusion, but this relationship was not found when participants responded to either the gender identity or fear of social exclusion questionnaire first. When participants completed the fear of social exclusion questionnaire first, there was not a significant correlation between gender identity and fear of social exclusion ($r(29) = -.12, p = .52$), gender identity and nerd identity ($r(26) = .02, p = .91$), or nerd identity and fear of social exclusion ($r(26) = .01, p = .97$). When participants completed the gender identity questionnaire first, there was not a significant correlation between gender identity and fear of social exclusion ($r(32) = -.13, p = .47$), gender identity and nerd identity ($r(31) = -.24, p = .19$), or nerd identity and fear of social exclusion ($r(31) = .12, p = .52$). The correlational results suggest that there were some carryover effects and the order of the questionnaire did seem to influence how participants responded to the second and third questionnaires. Importantly, however, the peer crowd, nerd identity, and gender identity scales were completed after the dependent variable, so any order effects could not affect participants' math scores.

Hypothesis One

A 2 (Gender: male vs. female) X 3 (Condition: no stereotype vs. gender stereotype vs. nerd stigma) ANOVA was conducted to test if there were any significant differences in math scores (See Table 2 for results). The study's main hypothesis stated that participants exposed to the nerd stigma would perform lower on the mathematics exam than participants not exposed to the nerd stigma. The ANOVA results showed that the effects between conditions were not significant, thus hypothesis 1 was not supported (Refer to Figure 3). Although not predicted, results also revealed a main effect of gender showing a significant decrease in female participant's math performance ($M = 12.50, SD = 4.44$) compared to male participant's math performance ($M = 15.42, SD = 6.09$). This effect was qualified by a significant interaction between gender and condition, $F(1,144) = 3.54, p = .03$. Since this interaction was used to

determine whether or not hypothesis 1a, 1b, and 1c was supported, multiple simple effect tests were conducted to analyze the interaction.

Table 2

Results for ANOVA examining the change in math performance.

Source	<i>df</i>	<i>F</i>	<i>p</i>	η^2
Gender	1	12.31	.00***	.08
Condition	2	2.52	.08	.03
Gender X Condition	2	3.54	.03*	.05
Error (Within groups)	144			

Note: * = $p \leq .05$, *** = $p \leq .001$.

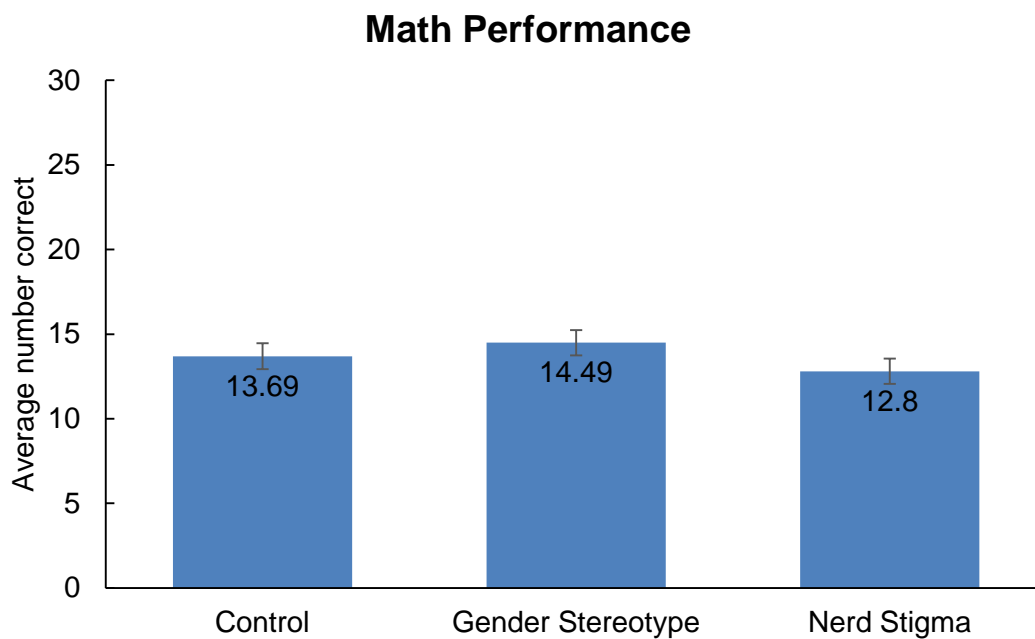


Figure 3. Math performance by condition. Main hypothesis 1 not supported.

Hypothesis 1a predicted that women would be negatively affected by the nerd stigma more than would men. An independent samples *t*-test showed that women in the nerd stigma condition did not perform significantly worse on the math test than men in the nerd stigma condition (See Table 3). An independent samples *t*-test showed that female participants scored

significantly lower on the math test than male participants in the gender stereotype condition (See Figure 4).

Table 3

Results for the differences between male and female participants' math performance in each condition

Condition	<u>Gender</u>		<i>t</i>	<i>df</i>
	Females	Males		
Control	13.29 (4.99)	14.24 (5.95)	-.61	47
Gender Stereotype	12.22 (3.45)	18.32 (5.79)	-4.72***	49
Nerd Stigma	12.07 (4.88)	13.90 (5.81)	-1.21	48

Note: * = $p \leq .05$, *** = $p \leq .001$. Standard deviations appear in parentheses below means.

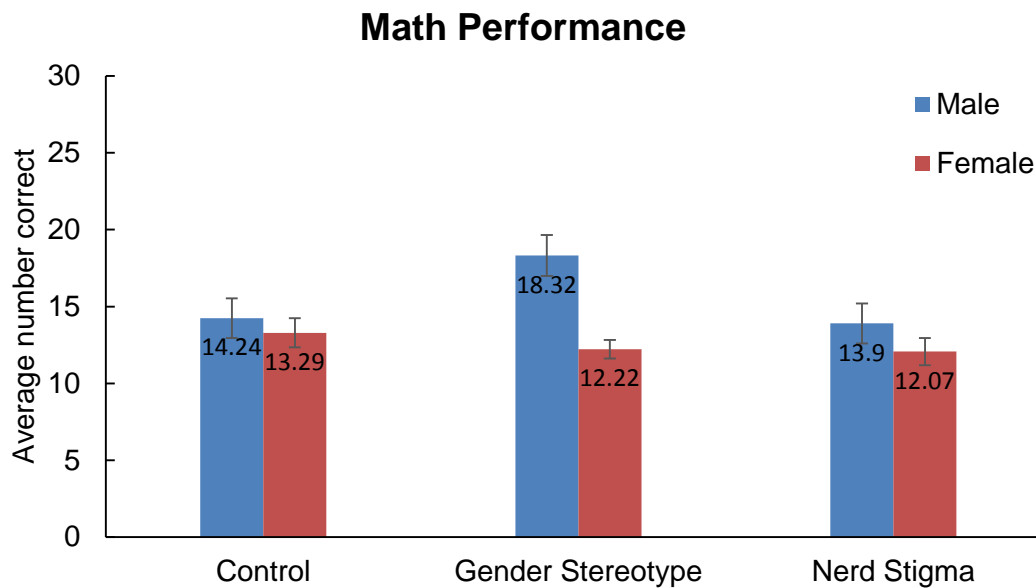


Figure 4. Math performance by gender and condition. Hypothesis 1a not supported. No differences between men and women in nerd stigma condition.

It was predicted in hypothesis 1b that female participants in the nerd stigma condition and the gender stereotype condition would score lower on the math exam compared to female participants in the control group. A one-way ANOVA between female participants in each condition (no stereotype vs. gender stereotype vs. nerd stigma) showed that there were no

significant differences between the three conditions, $F(2,87) = .64, p = .53$. Since this analysis revealed that female participants did not differ in math performances by condition, it also indicated that contrary to hypothesis 1c, female participants in the nerd stigma group did not score lower than female participants in the gender stereotype group.

In conclusion, a significant interaction was found between gender and condition, with male participants performing better on the math test than female participants in the gender stereotype condition. However, a follow up one-way ANOVA between conditions on just men showed a significant difference in math scores between conditions, $F(2,57) = 3.43, p = .04$. Post-hoc testing also showed that men in the gender stereotype condition ($M = 18.32, SD = 5.79$) performed significantly better than men in the nerd stigma condition ($M = 13.90, SD = 5.81$), $p = .03$ and significantly better than men in the control condition ($M = 14.24, SD = 5.95$), $p = .02$. Since male participants performed better on the math test in the gender stereotype condition than male participants in both the control and nerd stigma condition, this suggests that men's increase performance in the gender stereotype condition may be due to a boost from the stereotype that men perform better than women in mathematic tests rather than women performing worse in the gender stereotype condition (Shih et al., 2002). Although stereotype boost effects were not predicted, the results seem to replicate stereotype boost effects when men were exposed to the gender stereotype (Shih et al., 2002). Nevertheless, the results did not support hypothesis 1, 1a, 1b, or 1c.

Hypothesis 2

A 2 (Gender: male vs. female) X 3 (Condition: no stereotype vs. gender stereotype vs. nerd stigma) ANCOVA analysis was conducted with nerd identity as a covariate and interaction term to determine whether nerd identity was a moderator. Since the analysis revealed that nerd identity and condition were not a significant interaction, hypothesis 2 was not supported. Instead, results showed a significant interaction between gender, condition, and nerd identity (See Table 4). Several simple main effect ANOVA tests were then conducted to analyze the

three way interaction. Results indicated a significant interaction between condition (no stereotype vs. gender stereotype vs. nerd stigma) and nerd identity on female participant's math performance, $F(15,55) = 1.84$, $p = .05$ but not male participant's math performance, $p > .05$.

Table 4

Results for nerd identity as moderator

Source	<i>df</i>	<i>F</i>	<i>p</i>	η^2
Nerd Identity	12	1.33	.22	.16
Nerd Identity X Gender	8	.93	.50	.08
Nerd Identity X Condition	17	.89	.59	.15
Gender X Condition X Nerd Identity	10	2.42	.01*	.22
Error (Within groups)	87			

Note: * = $p \leq .05$, *** = $p \leq .001$.

Further analysis revealed only a marginal significant two way interaction between conditions (gender stereotype vs. nerd stigma) and nerd identity for female participants, $F(7,38) = 2.06$, $p = .07$. Female participants in the nerd stigma condition ($M = 12.00$, $SD = 5.04$) performed worse on the math test than female participants in the gender stereotype condition ($M = 12.59$, $SD = 3.09$). Examining the regression lines, the lines indicated that as nerd identity increased, female participants in the gender stereotype condition performed marginally better on the math exam than female participants in the nerd stigma condition (See Figure 5). There was also a marginal significant two way interaction between conditions (control vs. nerd stigma) and nerd identity for female participants, $F(8,35) = 1.96$, $p = .08$. Female participants in the control condition ($M = 13.29$, $SD = 4.99$) performed marginally better on the math test than female participants in the nerd stigma condition ($M = 12.00$, $SD = 5.04$). Examining the regression lines, as nerd identity increased in the control condition, female participants performed better on the math exam than female participants in the nerd stigma condition (See Figure 6).

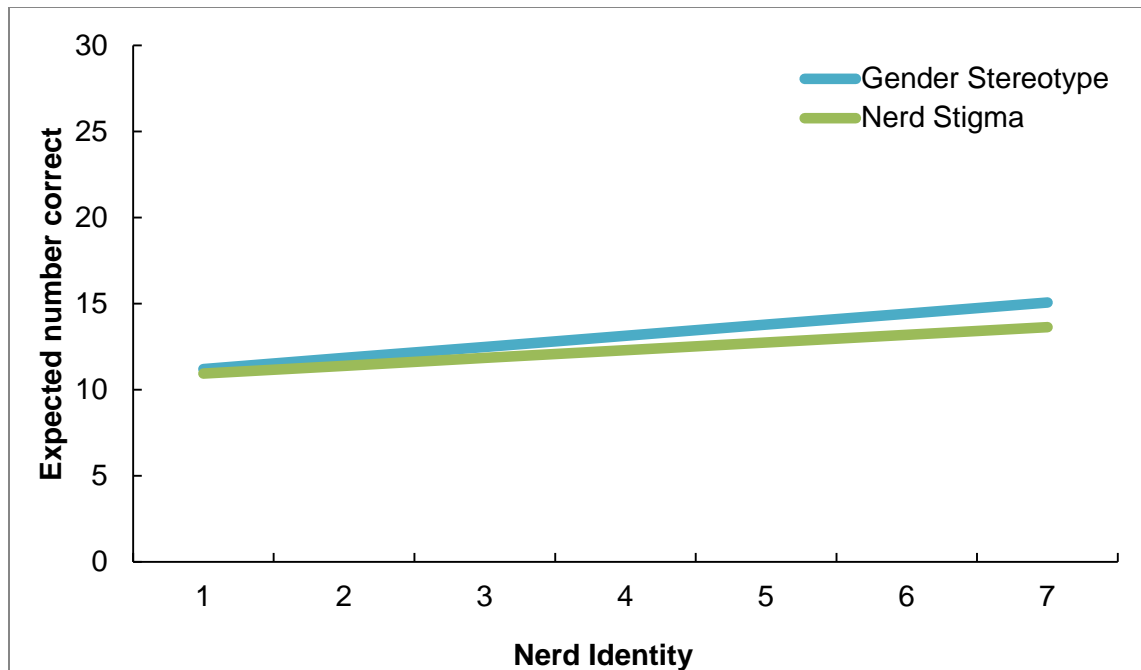


Figure 5. Linear regression lines showing two way interactions between condition (gender stereotype, nerd stigma) and nerd identity for female participants.

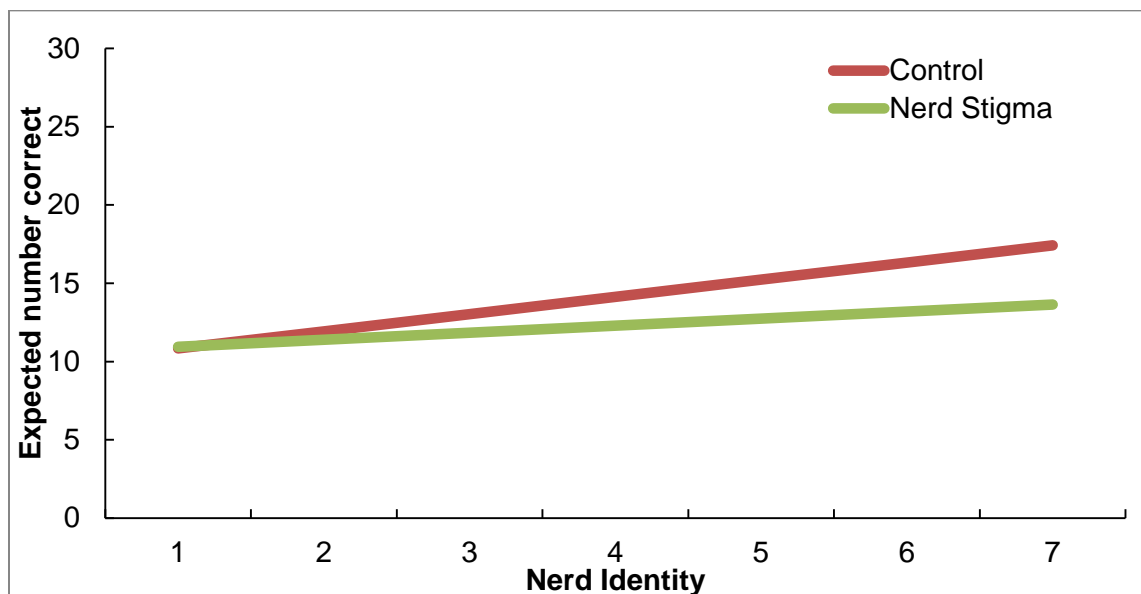


Figure 6. Linear regression lines showing two way interactions between conditions (control, nerd stigma) and nerd identity for female participants.

Contrary to prediction, nerd stigma participants high in nerd identity did not exhibit higher performance on a mathematics exam compared to control group participants high in nerd identity. Female participants low in nerd identity in the nerd stigma and control condition

appeared to perform similarly. It was predicted that exposure to the nerd stigma would lead to a stereotype boost in women with high nerd identity and lead to an increase in math performance, but data appears to show that the nerd stigma is associated with a decrease in math performance for female participants who highly identify with being a nerd. In fact, nerd identity was found to only moderate the nerd stigma effect among female participants, while simple main effect tests indicate only marginal significance between female participants in the nerd stigma and control condition and female participants in the nerd stigma and gender stereotype condition. These results suggest that female participants with high nerd identity performed worse when exposed to the nerd stigma compared to female participants with high nerd identity not exposed to the nerd stigma.

Hypothesis 3

To test whether gender identity was a moderator for nerd stigma effects a 2 (Gender: male vs. female) X 3 (Condition: no stereotype vs. gender stereotype vs. nerd stigma) ANCOVA analysis with gender identity as a covariate and interaction term was conducted. There were no significant interactions involving gender identity (See Table 5).

Table 5

Results for gender identity as moderator

Source	<i>df</i>	<i>F</i>	<i>p</i>	η^2
Gender Identity	19	1.34	.18	.25
Gender Identity X Gender	13	.59	.86	.09
Gender Identity X Condition	28	1.50	.08	.36
Gender X Condition X Gender Identity	7	.92	.50	.08
Error (Within groups)	75			

Note: * = $p \leq .05$, *** = $p \leq .001$.

Hypothesis 4

The last ANCOVA conducted was a 2 (Gender: male vs. female) X 3(Condition: no stereotype vs. gender stereotype vs. nerd stigma) with fear of social exclusion as a covariate and interaction term to test whether fear of social exclusion moderated the nerd stigma effects. There were no significant interactions involving fear of social exclusion (Refer to Table 6).

Table 6

Results for fear of social exclusion as moderator

Source	<i>df</i>	<i>F</i>	<i>p</i>	η^2
Fear of Social Exclusion	17	1.04	.43	.19
Fear of Social Exclusion X Gender	13	1.19	.31	.17
Fear of Social Exclusion X Condition	24	1.48	.10	.32
Gender X Condition X Fear of Social Exclusion	13	.52	.91	.08
Error (Within groups)	76			

Note: * = $p \leq .05$, *** = $p \leq .001$.

Hypothesis Five

Finally, it was hypothesized that the effect of the nerd stigma would be mediated by fear of social exclusion in women. Preliminary analyses were conducted to determine if a relationship between condition and the number correct on the math test was significant. A linear regression analysis revealed that the relationship between condition and the number correct on the math test was not significant, $r = .13$, $p = .11$. In addition, separating the relationships by sex also showed that male participants showed a significant link between the conditions and math performance, $r = .29$, $p = .02$ and female participants did not show a significant link, $r = .01$, $p = .91$. Since the study's hypothesis mostly pertained to women and the relationship between the conditions and math performance for female participants were not significant, mediated effects were not pursued.

In conclusion, the results did not show moderating effects of gender identity and fear of

social exclusion in female participants. Although nerd identity also did not moderate the nerd stigma effect as predicted, results found nerd identity only moderated nerd stigma effect of condition in female participants. Results on nerd identity suggested that female participants high in nerd identity performed worse on the math test when exposed to the nerd stigma. Results also did not show that among female participants, fear of social exclusion did not mediate the nerd stigma effects.

CHAPTER 4

DISCUSSION

The purpose of this experiment was to examine how nerd stigma affects math performance compared to the gender stereotype threat effects previously found (Spencer et al., 1999). The strong negative correlations between female's fear of being a nerd and math performance suggested that the nerd stigma may cause women to underperform in math (Boehnke, 2008). The main hypothesis (hypothesis 1) tested the effects of the nerd stigma on math performance and hypothesized that participants exposed to the nerd stigma would perform worse on the math exam compared to participants not exposed to the nerd stigma. The results did not support this hypothesis. Although participants exposed to the nerd stigma showed a decrease in math performance compared to participants not exposed to the nerd stigma (control condition and gender stereotype condition), this difference was not significant. Thus, exposure to the nerd stigma did not significantly decrease mathematic performance.

The next three hypotheses (1a, 1b, and 1c) tested the effects of the nerd stigma on math performance for female participants compared to male participants, female participants in the nerd stigma condition compared to female participants in the control and gender stereotype condition, and female participants in the nerd stigma condition compared to female participants in the gender stereotype condition. In hypothesis 1a, it was predicted that female participants would be negatively affected by the nerd stigma more than would male participants, but the results did not support this hypothesis. While female participants exposed to the nerd stigma did perform worse on the test than male participants exposed to the nerd stigma, this difference was not significant.

It was also hypothesized that female participants in the nerd stigma condition and the gender stereotype condition would score lower on the math exam compared to female participants in the control condition (hypothesis b) and also those in the nerd stigma condition

scoring similarly or lower on the math exam than the gender stereotype condition (hypothesis c), but these were also not supported. Again, female participants in both nerd stigma and gender stereotype conditions did score lower than female participants in the control condition and female participants in the nerd stigma condition also scored lower than the female participants in the gender stereotype condition, but neither analysis were significant. In conclusion, the nerd stigma did not significantly affect female participant's mathematics performance.

Instead, results only showed that compared to male participants, female participants tend to score lower on the math test. Following gender stereotype threat research, results showed that in the gender stereotype condition, male participants scored significantly higher on the math test than female participants. This difference in math performance between genders in the gender stereotype condition was partially expected, though not explicitly predicted, following stereotype threat research. Further analysis suggested that female participants did not perform worse on the math test; instead, male participants exhibited a stereotype boost on math performance in the gender stereotype condition and performed better on the math test than male participants in both the control and nerd stigma condition and female participants in the gender stereotype condition. Therefore, gender stereotype threat results were not replicated to accurately compare its effects with the nerd stigma effects.

The next three hypotheses (2, 3, and 4) tested whether nerd identity, gender identity, and fear of being a nerd moderated the nerd stigma effects on math performance. As a moderator, it was hypothesized that high nerd identity participants would score higher on the math exam but only for participants in the nerd stigma condition and not the control condition, but hypothesis 2 was not supported. Also not supported was the prediction that high nerd identity participants would exhibit a boost in math performance but only when participants were exposed to the nerd stigma. Although the data indicated a three-way interaction between gender, conditions, and nerd identity, further analyses showed only a significant two way interaction between conditions and nerd identity for female participants but not male

participants. A closer examination of the significant interaction between condition and nerd identity for female participants revealed marginal two way interactions between nerd identity and condition (nerd stigma and gender stereotype) and nerd identity and condition (nerd stigma and control). These two-way interactions suggest that nerd identity may in fact moderate the nerd stigma effects, but only for female participants and not male participants. Nevertheless, nerd identity was not found to moderate the effects of the nerd stigma in the way it was predicted.

It was also predicted that for female participants, gender identity would moderate the effect of the nerd stigma, but analysis did not support this hypothesis. Although gender identity showed a marginally significant two way interaction between gender and condition, this was not significant. Lastly, it was hypothesized that fear of social exclusion would moderate the nerd stigma effect, but again this was not supported.

Overall, gender identity and fear of social exclusion were not found to moderate the effects of the nerd stigma. Although nerd identity was found to moderate math performance only for women, this was not predicted. In conclusion, results do not support the predictions made regarding the nerd identity, gender identity, and fear of social exclusion's moderated role in the effects of the nerd stigma.

The last hypothesis predicted that the nerd effects on math scores were mediated by fear of social exclusion for female participants. Preliminary analyses revealed that there was no significant relationship between the conditions and math scores so analyses were not performed for mediation. Thus, contrary to prediction, fear of social exclusion did not mediate the effects of nerd stigma for female participants' on math scores.

Limitations

There are several limitations to the current study. One limitation to the study was the low sample size. Although the necessary 20 participant per condition was reached (Simmons, Nelson, & Simonsohn, 2011), the statistical tests were still very underpowered because of the low sample size (Simmons et al., 2011). Recently, Simmons, Nelson, and Simonsohn (2013)

argued that to prevent false positives, at least 50 participants per condition should be used in a research design. Due to the limits of the subject pool, only 150 participants completed the study. Thus, a larger sample size of 50 participants per cell could increase statistical validity of the mediation and moderation analyses and overall ANOVA analyses.

Also, almost 30% of the participants responded incorrectly to the manipulation check question about seeing the picture, suggesting that the picture manipulation needed to be either stronger or the phrasing of the manipulation question needed to be clearer to participants. A discussion with the second experimenter suggest that some participants were unsure if the manipulation check question referred to the picture they saw early on the test or if another picture was supposed to be shown on the manipulation check page. Thus, some participants were aware they saw a picture but may have misunderstood the question. Another possibility was that the picture manipulation was not strong enough to elicit the correct effects of a nerd stigma in the nerd stigma condition and gender stereotype in the gender stereotype condition. Although participants rated the nerd pictures as more nerdy than the gendered pictures, a closer review showed that participants in the nerd stigma condition did not view the individual in the picture to be nerdy. On a Likert scale from 1 (*strongly disagree*) to 5 (*strongly agree*), participants in the nerd stigma condition disagreed that the individual in the picture was a nerd ($M = 2.24$, $SD = 1.57$). This suggests that the nerd picture was not strong enough to elicit the nerd stigma effect and may have led to the lack of findings in the current study.

Upon reviewing the pilot participant's ratings of the manipulation pictures, data revealed that the pilot participants rated the nerd pictures as more nerdy ($M = 3.38$, $SD = 1.01$) than participants in the current study. The difference in pilot participant and current participant's ratings on the nerd pictures suggest several other limitations to the study. First of all, pilot participants rated the pictures immediately after viewing each picture, while the participants in the current study saw the picture before completing the math test and rated the picture after completing the math test. Since participants were given 20 minutes to complete the math test,

the time difference between seeing the picture and rating the picture may have led the nerd stigma effect to diminish and may have influenced how participants in the current study rated the nerd pictures. By the end of the math test, participants in the current study may have remembered less about the picture or the nerd stigma effects may have diminished; thus leading to lower nerd ratings for the nerd pictures. Perhaps future research can re-show the picture on the manipulation check page before participants responded to the manipulation check questions. Secondly, pilot participants saw and rated all the pictures whereas participants in the current study only saw one picture. Pilot participants were shown each picture individually and rated the picture immediately after seeing the picture before being shown the next picture. By seeing one picture after another, pilot participants may have been comparing the newer pictures with the pictures that were previously shown, thus resulting in the differences in how pilot and current participants rated the pictures. In fact, pilot participants rated the nerd pictures above the midpoint of the nerdiness scale, whereas the current participants rated the nerd pictures below the midpoint of the nerdiness scale. Although the pilot participants rated the nerd pictures more nerdy than the current participants, both samples did not agree that the individuals in the nerd pictures were very nerdy.

A possible explanation to this difference in rating of the nerd picture may be due to the participant's race. Almost half of the participants in the current study were African American. My hypotheses rely on the fear of the nerd stigma, but the picture stimuli used were of two White women and one White and one Hispanic man. A picture stimulus of Black men and women were not used for Black participants, therefore the nerd stigma may not have been activated for the Black participants. This means that almost half of the participants may not have had activated the construct of the manipulation. Analysis showed that Black participants ($M = 11.17$, $SD = 4.05$) performed significantly worse on the math test than White participants ($M = 15.59$, $SD = 5.47$), $t(137.98) = -5.50$, $p < .01$, which may have concealed an effect of the manipulation on White participants. Further analysis were conducted comparing only White participants'

math performance with a 2 (Gender: male vs. female) X 3 (Condition: no stereotype vs. gender stereotype vs. nerd stigma) ANOVA and results showed that the two way interaction was only marginally significant, $F(2,74) = 2.43$, $p = .10$. In the gender stereotype condition, male participants ($M = 19.46$, $SD = 6.23$) performed significantly better on the math exam than female participants ($M = 13.11$, $SD = 3.20$), $t(25.73) = 4.17$, $p \leq .01$. There was also a significant main effect of gender, with male participants ($M = 17.46$, $SD = 5.95$) performing significantly better on the math test than female participants ($M = 14.13$, $SD = 4.63$), $F(1,74) = 5.72$, $p = .02$.

According to Cool Pose Theory, social status is so important in African American culture that African American students would purposely perform worse in school to maintain their social status (Majors & Billson, 1993). Thus, the nerd manipulation may not have activated the way it was intended to for Black participants. It is also possible that other races may have different description of how nerds look, thus the criteria set for nerds in the pictures used for the current study may not be how Black, Asian, or Hispanic participants view a nerd. Thus, a stronger and more accurate nerd manipulation needs to be developed for future studies.

Lastly, the direction the individual in the picture was facing may affect how participants perceived the individual in the picture. In the picture manipulations, the individuals are always looking down at the table. For the current study, participants in the experimental conditions were asked to imagine taking a math test similar to the individual in the picture. This could remind participants of their more relaxed attire on test days compared to an average day. It is in my experience that students tend to dress less neat and proper on test days, perhaps because they didn't have time to fix their hair or choose appropriate attire for the day. Thus, participants in the current study may associate the individual in the nerd picture as a normal individual on a test day who didn't have time to dress in a clean and attractive manner instead of a nerd. Pilot participants, on the other hand, were not given any extra context, thus they only rated the picture itself and did not make an association that the individual in the picture was a normal

individual. Therefore, the construct of the manipulation may not have been activated strongly enough to elicit the nerd stigma effects.

In the current study, another possible limitation would be that participants completed the study in mixed gendered groups. Previous stereotype threat research found that on average, women exhibited lower math performance when in the presence of two men than in the presence of two women or one man and one woman (Inzlicht & Ben-Zeev, 2000). Thus, without controlling for who else the participants were in the room with, it is difficult to determine whether female participant's math performance in the current study were affected by the sex of the other participants in the room with them. Since this was not examined in the current study, future research should examine whether the nerd stigma effect changes participant's math performance when participants complete the math test in same gendered groups and mix gendered groups.

The peer crowd, gender identity, and fear of social exclusion questionnaires were also possible limitations in the current study. As previously mentioned, these questionnaires were supposed to be randomly ordered to counterbalance any carryover effects but the orders of the questions were not randomly ordered. Thus, presenting one of the three questionnaires first may have influenced the participant's response to the other two questionnaires. In fact, correlational analysis suggested that completing the peer crowd questionnaire first may have affected how participants responded to the next two questionnaires.

Timing of when the fear of social exclusion, gender identity, and peer crowd questionnaires were presented may also be a possible limitation in the study. In the current study, these questions were presented after the math test. To identify nerd identity, gender identity, and fear of social exclusion as moderator variables, a cleaner design could measure these individual variables a couple of weeks before participants came into the lab to complete the study (MacKinnon, 2011). But, due to time constraints, participants did not answer the nerd identity, gender identity, and fear of social exclusion questionnaire until after the math test.

Thus, it is possible that the manipulation or math test may have influenced the participant's response to these questionnaires.

Another possibility would be to present the fear of social exclusion questions immediately after the manipulation to test for mediation effects. It was predicted that fear of social exclusion mediated the nerd stigma effects for women. In other words, after the female participant saw the nerd picture, the nerd stigma effect should have affected the participant's level of fear of social exclusion. This fear of social exclusion should in turn affect the female participant's math performance. Thus, to accurately measure mediation, the fear of social exclusion questionnaire should have been presented immediately after the manipulation (MacKinnon, 2011). By placing the fear of social exclusion questionnaire after the math test, it is difficult to determine whether or not the fear of social exclusion questions were actually measuring the fear exhibited from the manipulation or measuring the fear exhibited from the participant's math performance. Therefore, presenting the questionnaires after the math test limited how the analysis of these questionnaires can be viewed.

One major limitation in this study was the inability to recruit high school students as participants. Research on nerd crowds suggest that the term "nerd" is more prominent in a high school environment and high school students are the ones who are most affected by the nerd stigma. In high school, students are constantly pressured to succeed so that they can attend college. Not only do high school students need to perform well in their classes and get a high G.P.A. but they need to get a high SAT score as well just to be competitive enough to apply to colleges. The multitude of tests and high achievement necessary to attend a college in the future can be significantly debilitating if being smart and performing well in classes can be seen by fellow peers as "nerdy." Although the current sample rated that the nerd crowd still existed at Georgia Southern University (where participants were recruited) the larger environment of a university may diminish the effects of belonging in the nerd crowd. High school environments are significantly smaller and will more likely highlight the relevance of identifying with certain

groups. It would be beneficial for future researchers to conduct a similar study using high school students as participants.

Future Directions

As previously mentioned, future research can conduct a similar study but with high school participants, a larger sample size, a stronger nerd manipulation, or differentiate when fear of social exclusion, gender identity, and nerd identity questions are presented to the participants, but these are not the only possibilities.

For example, a more reliable scale to measure fear of social exclusion and nerd identification should be created to examine the moderating and mediating effects. The original fear of social exclusion scale used by Boehnke (2008) only consisted of one question. Although three additional questions were added to the scale in the current study, these four questions may not provide an accurate measurement of the fear. In fact, the questions may not reveal fear of being a nerd, but something else entirely. The nerd identification scale, on the other hand, was not used in any previous study. Nerd identity was examined in this study by simply averaging participant's response to how much they identified with being a nerd in high school and at Georgia Southern University. Although the scale was found to be reliable, a new scale tested with larger participant pools can provide a more accurate measurement for nerd identification.

In addition, the lower math scores for female participants high in nerd identity exposed to the nerd stigma compared to female participants high in nerd identity not exposed to the stereotype (control condition) also suggests another interesting direction to examine. Future research can examine why female participants high in nerd identity did not benefit from the exposure to the nerd stigma. Perhaps women who highly identify with being a nerd may be satisfied with identifying themselves as a nerd but do not want others to identify them as a nerd. The fear of being identified as a nerd by peers may subconsciously lead women to perform worse on the math exam. One possible analysis is to conduct an ANCOVA analysis with fear of

social exclusion and nerd identity as covariates and interaction terms. Thus, female participants high in nerd identity in the current study performed worse on the math test perhaps because they are also high in fear of social exclusion. Female participants with high academic abilities may view themselves as a nerd, but feared being socially excluded by their peers led these female participants to perform worse on the math test. Although this was not predicted, it follows Boehnke (2008)'s finding that there was a high correlation for girls with high academic abilities with a high fear of social exclusion to perform worse in math.

It is also possible that women high in nerd identity exhibit lower performance on the math test because of a social comparison process. After being exposed to the nerd stigma, female participants high in nerd identity may have saw the nerd image as an upward comparison standard and felt anxious (Blanton, Buunk, Gibbons, & Kuyper, 1999). The anxiety may have female participants in the nerd stigma condition to exhibit lower performance on the math test. Since social comparison was not tested in the current study, this is only speculative. Future research can be conducted to examine whether social comparison plays a role in nerd stigma.

Conclusions

Although this study did not find support for nerd stigma effects, the lack of support to replicate gender stereotype threat indicates that perhaps the manipulation or study design was not strong enough to bring out the nerd stigma effect. The gender stereotype condition was originally included to allow a clearer comparison with the effects proposed by the nerd stigma theory. Since gender stereotype threat was not replicated in this study, it follows that nerd stigma can still be supported in a future study that fully replicates gender stereotype threat. Perhaps if future research makes the appropriate changes to the limitations of this current study, the nerd stigma effect can be supported.

However, this study did have several strengths that should not be overlooked. The current study proposed a new theory regarding nerd stigma that, to my knowledge, has not

been experimentally tested. Thus, extensive research and time were put into creating the nerd manipulation. One sample of participants provided feedback on what a nerd wore and looked like to use as the criteria for a nerd. After these criteria were determined, volunteers were recruited to have a two pictures taken of them (a nerd picture and a gendered picture). A second sample of participants then rated these pictures to ensure that the nerd pictures did appear nerdy and the gendered pictures did not appear nerdy. Additional pictures of both new and old volunteers were taken when the pilot participants did not rate the nerd pictures as nerdy and the gendered pictures as not nerdy. This process of retaking pictures and having pilot participants rate the pictures were repeated several times before a decision was made to use the pictures in the current study. Thus, although there were several limitations to the picture manipulation, these pictures were tested several times before being used.

The term “nerd” is part of our everyday language, but very limited research has examined the effects it has on different individuals. More importantly, to my knowledge, no other research has attempted to compare the proposed nerd stigma effects with the effects found in gender stereotype threat research. Therefore, it is not surprising to find so many limitations in the current study. Not only is nerd stigma a new concept, but it is attempting to compare with a largely studied theory, stereotype threat. Results showed that math scores did follow the predicted trend of lower math performance when participants were exposed to the nerd stigma. Therefore, if this study’s limitations are addressed, nerd stigma effects may be shown and result in a new possible explanation to the gender gap in mathematics.

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Appendix A: Math Exam

Note: In the problem sets the number in parentheses after the problem number is the average solution rate in the population used in Jamieson and Harkin's study, and the letter is the answer.

Please correctly complete as many problems as you can in 20 minutes. There is no penalty for guessing.

1. (86, d) A purchase plan for a stereo receiver requires 20% of the total cost as a down payment and monthly payments of \$30.

Column A

The total cost of the receiver

Column B

\$450

- a. The quantity in Column A is greater
- b. The quantity in Column B is greater
- c. The two quantities are equal
- d. The relationship cannot be determined from the information given

2. (84, b)

Column A

$\sqrt{82,531}$

Column B

300

- a. The quantity in Column A is greater
- b. The quantity in Column B is greater
- c. The two quantities are equal
- d. The relationship cannot be determined from the information given

3. (70, e) Of the following fractions, which has the least value?

- a. $\frac{8}{7}$
- b. $\frac{8}{9}$
- c. $\frac{5}{6}$
- d. $\frac{7}{8}$
- e. $\frac{7}{9}$

4. (75, c) If $(y/x) = -1$, then $y + x =$

- a. -2
- b. -1
- c. 0
- d. 1
- e. 2

5. (d, 66)

$$x \neq 0$$

Column A
 x

Column B
 $1/x$

- a. The quantity in Column A is greater
- b. The quantity in Column B is greater
- c. The two quantities are equal
- d. The relationship cannot be determined from the information given

6. (81, e) Each of the following is the square of an integer EXCEPT

- a. 81
- b. 100
- c. 121
- d. 196
- e. 215

7. (74, b) If $4x - 2y = 8$, what is the value of $2x - y$?

- a. 3
- b. 4
- c. 5
- d. 6
- e. It cannot be determined from the information given

8. (76, c)

$$\begin{aligned} 2x + y &= 6 \\ y &= x \end{aligned}$$

Column A
 $x + y$

Column B
 $3x - 2$

- a. The quantity in Column A is greater
- b. The quantity in Column B is greater
- c. The two quantities are equal
- d. The relationship cannot be determined from the information given

9. (79, b) If $b - c = 3$, and $a + c = 32$, then $a + b =$

- a. 30
- b. 35
- c. 40
- d. 42
- e. 50

10. (71, a) If $y = 3x$ and $z = 2y$, then in terms of x , $x + y + z =$

- a. $10x$
- b. $9x$
- c. $8x$
- d. $6x$
- e. $5x$

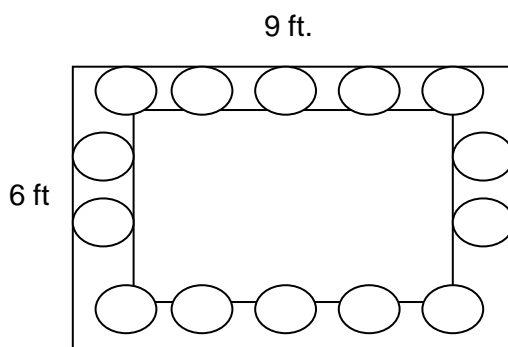
11. (82, a)

$$\frac{\text{Column A}}{2 + \sqrt{3}}$$

$$\frac{\text{Column B}}{1 + \sqrt{4}}$$

- a. The quantity in Column A is greater
- b. The quantity in Column B is greater
- c. The two quantities are equal
- d. The relationship cannot be determined from the information given

12. (62, a) The rectangular rug shown in the figure below has a border 1 foot wide on all sides. What is the area, in square feet, of that portion of the rug that excludes the border?



- a. 28
- b. 40
- c. 45
- d. 48
- e. 53

13. (70, b) R , S , and T are consecutive **odd** integers and $R < S < T$.

$$\frac{\text{Column A}}{R + S + 1}$$

$$\frac{\text{Column B}}{S + T - 1}$$

- a. The quantity in Column A is greater
- b. The quantity in Column B is greater
- c. The two quantities are equal
- d. The relationship cannot be determined from the information given

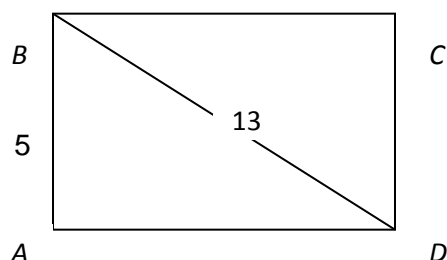
14. (72, a) A spraying machine uses 6 full 5-gallon buckets of fungicide every 20 minutes.

Column A
The number of gallons of fungicide the machine uses during 8 hours of spraying

Column B
140

- a. The quantity in Column A is greater
- b. The quantity in Column B is greater
- c. The two quantities are equal
- d. The relationship cannot be determined from the information given

15. (71, a)



$ABCD$ is a rectangle

Column A
The area of region $ABCD$

Column B
50

- a. The quantity in Column A is greater
- b. The quantity in Column B is greater
- c. The two quantities are equal
- d. The relationship cannot be determined from the information given

16. (83, b) 42 is what percent of 70?

- a. 57%
- b. 60%
- c. 67%
- d. 70%
- e. 167%

17. (79, b) If p is a positive integer, which of the following could be a prime number?

- a. $8p$
- b. $8p + 1$
- c. $8p + 2$
- d. $8p + 4$
- e. $8p + 6$

18. (76, a)

$$(2t) / 5 = 5$$

Column A
 t^2

Column B
144

- a. The quantity in Column A is greater
- b. The quantity in Column B is greater
- c. The two quantities are equal
- d. The relationship cannot be determined from the information given

19. (77, a) In a certain school, 75 students are enrolled in English, 85 students are enrolled in mathematics, and 60 students are enrolled in both.

Column A
The ratio of the number of students enrolled in both English and mathematics to the number of students enrolled in English

Column B
 $3 / 5$

- a. The quantity in Column A is greater
- b. The quantity in Column B is greater
- c. The two quantities are equal
- d. The relationship cannot be determined from the information given

20. (81, c) If $(\frac{4}{3})n = (\frac{3}{7})$, then $n =$

- a. $\frac{1}{28}$
- b. $\frac{3}{14}$
- c. $\frac{9}{28}$
- d. $\frac{13}{28}$
- e. $\frac{1}{2}$

21. (74, b)

Column A
 $1 - (\frac{1}{7})$

Column B
 $1 - (\frac{1}{8})$

- a. The quantity in Column A is greater
- b. The quantity in Column B is greater
- c. The two quantities are equal
- d. The relationship cannot be determined from the information given

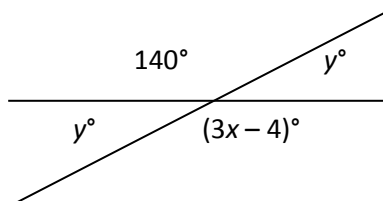
22. (74, c) If $2x = -10$, then $4x^2 - 6x - 5 =$

- a. 65
- b. 75
- c. 125
- d. 130
- e. 135

23. (66, a) How many even integers are between $(\frac{17}{4})$ and $(\frac{47}{2})$?

- a. nine
- b. eight
- c. six
- d. five
- e. four

24. (67, a)

Column A x Column B y

- a. The quantity in Column A is greater
- b. The quantity in Column B is greater
- c. The two quantities are equal
- d. The relationship cannot be determined from the information given

25. (76, c) The length of a rectangular floor is 16 feet and its width is 12 feet. If each dimension were reduced by s feet to make the ratio of length to width 3 to 2, what would be the value of s ?

- a. 0
- b. 2
- c. 4
- d. 6
- e. 8

26. (71, c)

$$24x = 18y$$

Column A $4x$ Column B $3y$

- a. The quantity in Column A is greater
- b. The quantity in Column B is greater
- c. The two quantities are equal
- d. The relationship cannot be determined from the information given

27. (74, c)

$$\begin{aligned}x^2 + 3 &= 19 \\ x &< 0\end{aligned}$$

Column A
 x

Column B
 -4

- a. The quantity in Column A is greater
- b. The quantity in Column B is greater
- c. The two quantities are equal
- d. The relationship cannot be determined from the information given

28. (77, d) Sue drives 10 miles from home to work. If she could average 50 miles per hour, how many minutes would it take her to drive from home to work?

- a. 20
- b. 18
- c. 15
- d. 12
- e. 10

29. (75, b)

Column A
 100^2

Column B
 2^{100}

- a. The quantity in Column A is greater
- b. The quantity in Column B is greater
- c. The two quantities are equal
- d. The relationship cannot be determined from the information given

30. (73, b) Of the following, which is closest to $(0.26 \times 397) / 9.9$?

- a. 1
- b. 10
- c. 70
- d. 100
- e. 700

Appendix B: Pictures for manipulation

Women

Gender



Nerd



Gender



Nerd



Male

Gender



Nerd



Gender



Nerd



Appendix C: Fear of social exclusion questionnaire

Directions: Please indicate your agreement or disagreement with the questions below.

1. I sometimes worry about being seen as a nerd.

1	2	3	4	5	6
Strongly disagree	Disagree	Somewhat disagree	Somewhat agree	Agree	Strongly agree

2. I do not want to be labeled as a nerd.

1	2	3	4	5	6
Strongly disagree	Disagree	Somewhat disagree	Somewhat agree	Agree	Strongly agree

3. I try to not look nerdy.

1	2	3	4	5	6
Strongly disagree	Disagree	Somewhat disagree	Somewhat agree	Agree	Strongly agree

4. I am comfortable being labeled a nerd.

1	2	3	4	5	6
Strongly disagree	Disagree	Somewhat disagree	Somewhat agree	Agree	Strongly agree

Appendix D: Peer crowd questionnaire

Directions: Please think back to when you were in high school while answering the following questions.

1. Were these crowds present at your school:

Jocks	(Yes/No)
Deviants	(Yes/No)
Popular	(Yes/No)
Nerds	(Yes/No)
Loners	(Yes/No)
Normal	(Yes/No)

2. Please list any alternate names for the crowds, and describe any additional crowds that existed in your high school.

3. In high school, I identified myself with:

	Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly agree
Jocks	1	2	3	4	5
Deviants	1	2	3	4	5
Popular	1	2	3	4	5
Nerds	1	2	3	4	5
Loners	1	2	3	4	5
Normal	1	2	3	4	5

Directions: Please think about your time at Georgia Southern University (GSU) while answering the following questions.

1. Are these crowds present at GSU:

Jocks	(Yes/No)
Deviants	(Yes/No)
Popular	(Yes/No)
Nerds	(Yes/No)
Loners	(Yes/No)
Normal	(Yes/No)

2. Please list any alternate names for the crowds mentioned above and describe any additional crowds that exist at GSU.

3. I currently identify myself with:

	Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly agree
Jocks	1	2	3	4	5
Deviants	1	2	3	4	5
Popular	1	2	3	4	5
Nerds	1	2	3	4	5
Loners	1	2	3	4	5
Normal	1	2	3	4	5

Appendix E: Gender identity questionnaire

INSTRUCTIONS: Please read each statement carefully, and respond by circling a number on the scale from 1 to 7:

		Strongly disagree	Disagree	Somewhat disagree	Neither agree or disagree	Somewhat agree	Agree	Strongly agree
1	Being a man/woman is an important part of my self-image	1	2	3	4	5	6	7
2	Being a man/woman is an important reflection of who I am	1	2	3	4	5	6	7
3	Being a man/woman is unimportant to my sense of what kind of person I am	1	2	3	4	5	6	7
4	Being a man/woman has very little to do with how I feel about myself	1	2	3	4	5	6	7

Appendix F: Demographics questionnaire

Instructions: Please answer the following questions about your background.

Your sex: ☐ Male ☐ Female

Your ethnicity/race:

☐ African American/Black

☐ European American/White

☐ Native American

☐ Asian American

☐ Hispanic American

☐ Not a U.S. citizen (fill-in nationality _____)

Your age: _____

Year in college:

☐ Freshman

☐ Sophomore

☐ Other

☐ Junior

☐ Senior

Major: _____

Please circle all math classes that you have currently completed and when it was completed (in high school [HS] or college [GSU]). On the blank line, please indicate the grade you received in the class:

Grade	Class	Completed In	Grade	Class	Completed In
_____	Algebra	(HS) or (GSU)	_____	Geometry	(HS) or (GSU)
_____	Precal/Trig	(HS) or (GSU)	_____	Calculus	(HS) or (GSU)
_____	Statistics	(HS) or (GSU)	_____	Other: _____	(HS) or (GSU)

Your GPA in high school: _____

Your current GPA: _____

Total SAT score _____

Math SAT score _____

Verbal SAT score _____

Appendix G: Manipulation checks

Directions: Please indicate your agreement or disagreement with the questions below by rating each item on the following scale:

The individual in the picture is:

	Strongly disagree	Disagree	Neither agree or disagree	agree	Strongly agree	Did not see a picture
A Nerd	1	2	3	4	5	N/A
Attractive	1	2	3	4	5	N/A
Feminine	1	2	3	4	5	N/A
Masculine	1	2	3	4	5	N/A

Confound checks

Do you know the person in the picture?

- a. Yes
- b. No
- c. Did not see a picture

The exam was:

1	2	3	4	5	6
Very	Easy	Somewhat	Somewhat	Difficult	Very
Easy		Easy	Difficult		Difficult